Andalay® Solar

Installation Guide

Sloped Roof Mounting System
(60-Cell Modules)

Version 2.5

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Place of Origin: This manual, and the techniques, methods and IP contained within it, were created in the United States of America. Andalay Solar systems contain some foreign made components. Assembly, design and distribution takes place through operations located within and outside the United States of America.

Protected by U.S. patents (7,406,800; 7,832,157 and 7,866,098), and foreign patents (2,005,248,343; 243,626; 274,182 and 751,614). Other patents pending.

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Chapter 1: Introduction

For more than a century, Andalay has stood for reliability and innovation, developing solutions that deliver safe and efficient electrical energy, while introducing smart products for the home that bring comfort and convenience to the lives of millions. Today, that tradition continues with Andalay Solar Power Systems, which are safer, more powerful, and more reliable than any other, while backed by the proven quality of the Andalay name.

1.1: Features & Benefits

Rapid design and installation

- Design eliminates need for separate rack systems
- Automates panel-to-panel mounting, grounding, and electrical connections.
- 80% fewer parts and 50% less labor than ordinary solar power systems.

Designed for all roof types

- Composition Shingle
- Flat Tile
- S and Barrel Tile
- Standing Seam

Ruggedized construction

- Engineered to exceed wind and snow load requirements established by local building codes, enabling installations in more regions.

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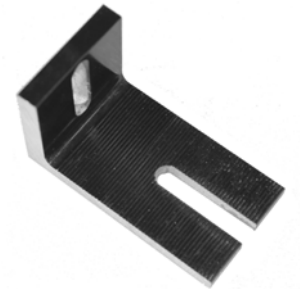
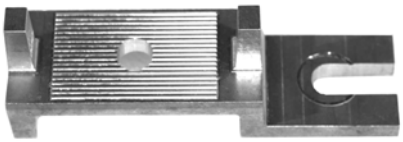
1.2: Primary Components

The primary components include:



L Bracket



North/South Bracket

G-Bolts

Splice

1.3: Other Components

Other required components required for installation (not shown) include:

- Flashings as appropriate for the roof type and all applicable codes
- Roof sealant
- Offset L brackets
- Grounding Lugs
- Wire Management Clips
- 5⁄16” lag-Bolts
- 5⁄16” flat washers
- 3⁄8” hex bolts
- 3⁄8” flange nuts

1.4: Additional Considerations:

The following considerations must be determined on a case-by-case basis:

- Determine the type of flashing required to conform to roofing warranty requirements and all applicable building codes.
- Determine the type of roofing sealant required to conform to all applicable building codes.

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- Refer to the Technical Evaluation Report, available at http://www.Andalaysolar.com/index.php/dealer-resources, to determine adequate lag bolt strength, hex bolts, or G-bolts.
- The Andalay Solar 5° Sloped Roof Mounting System is designed to work with 60-cell AC and DC Modules mounted in either landscape (horizontal) or portrait (vertical) orientation:

1.5: Required Tools

The following tools are needed in order to install the Andalay Solar Sloped Roof Mounting System (available from any tool source):

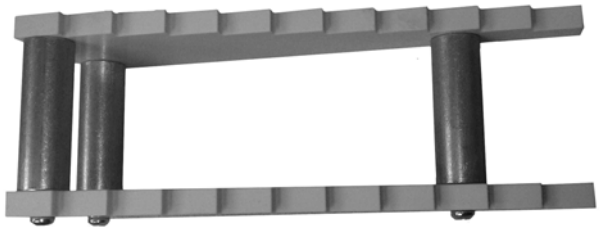
Ratchet (1/4" drive)

Torque Wrench

Power driver

The following special tools are available from Andalay Solar:

Andalay Solar wrench



Step Block

Landscape Splice Driver

Portrait Splice Driver

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1.6: Safety Precautions

Installation procedures should be performed in compliance with local Authority Having Jurisdiction regulations, OSHA protection codes, most recent National Electrical Code, ANSI/NFPA 70, local utility requirements, and other applicable guidelines that pertain. For more information, please check the OSHA Part 1926 for information regarding safety.

1.6.1: General Safety

- **Fall Hazards:** *OSHA Part 1926-Subpart M* contains fall-protection regulations for all roof edges, including all necessary guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones, and other required protective equipment and measures
- **Weather Hazards:** Performing installations in overcast conditions can cause severe bodily injury.
- **Electrical Hazards:** *OSHA Part 1926-Subpart K* contains hazard-protection regulations for working with live electrical equipment and/or high voltage, including a 10’ minimum clearance from overhead power lines and using the proper barriers and other forms of guarding when live parts of electric equipment and circuits are exposed.
- **Lifting Hazards:** Always follow smart lifting practices to avoid back and general body injury. For more information, check Section VII: Chapter 1 in the *OSHA Technical Manual*.
- **Hand and Power Tools:** *OSHA Part 1926-Subpart I* contains regulations regarding tool usage during installation. Always check equipment before use to verify correct functionality and avoid any bodily injuries. Always secure and properly store all equipment when not in use.
- **Materials Handling:** O*SHA Part 1926-Subpart H* requires that all materials shall be stacked, interlocked, and secured to prevent sliding, falling, or collapsing, which could cause severe body harm. Handle sharp edges of system components using proper equipment.

1.6.2: Installation Safety

- Installation procedures should be performed by trained and licensed personnel who are experienced in installing photovoltaic systems.
- Do not expose Modules to excessive loads as this might cause damage and malfunction.
- Always use proper safety and installation gear such as (but not limited to) gloves, goggles, hard hats and head protection, hearing protection, safety vests, and proper tools.
- Solar Modules generate electricity when exposed to light and can cause lethal shock and burn hazards.
- Perform all electrical installations in accordance with all local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.
- Follow NEC requirements for grounding, including those in Article 250 and Article 690.

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- Only qualified personnel should install, service, and/or replace Andalay Modules. Electrical components can be dangerous for installation personnel who are unfamiliar with appropriate safety procedures.
- Read all instructions and cautionary markings in this manual before installing or using the Andalay Module
- Tampering with Modules may void the warranty and/or cause serious bodily injury. Modules contain no user-serviceable parts. To replace a defective Module, please contact Andalay customer service to obtain an RMA number.
- Never connect or disconnect a Module when the system is energized. Only energize the system once all Modules are completely assembled and inspected.
- Never touch live terminals with bare hands. Use insulated tools for electrical connections.
- Never strike glass Module surfaces with heavy or sharp objects, and never walk on Module surfaces. The glass surface may fracture, disabling the Module and voiding the warranty.
- Never direct artificially-concentrated sunlight onto the Modules.

1.7: For Further Information

Please refer to the PV Module *Installation and Operations* manual available at www.Andalaysolar.com/index.php/dealer-resources for additional information and instructions for installing Andalay Solar AC and DC PV Modules, including:

- Additional safety instructions
- Regulatory information
- Recommended Applications
- Bonding
- Wiring
- Commissioning

The information in the *Installation and Operations* manual varies by Module type/model and is beyond the scope of this manual.

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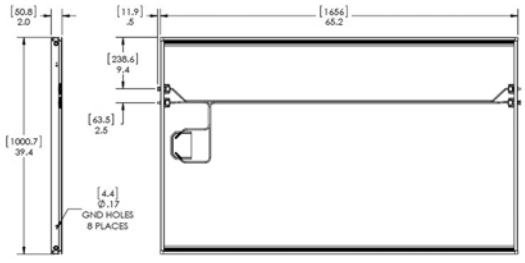
Chapter 2: System Design

Andalay Solar systems require 80% fewer parts than ordinary solar systems; the simplicity of having fewer parts transfers directly into the ease of the design process. Andalay Solar panels may be oriented in either a “portrait mode” or a “landscape mode”. Portrait mode minimizes roof penetrations and AC wiring, resulting in faster installation times. Landscape mode may also be used for added flexibility. The design of the Andalay Solar Power System also accommodates mixed portrait and landscape installations.

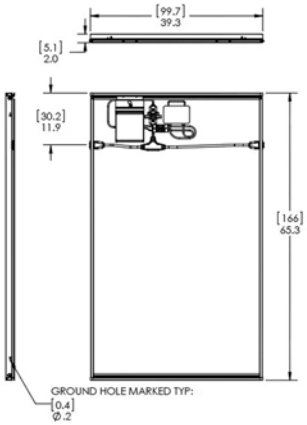
2.1: Module Types

Andalay Solar sloped roof mounting systems are compatible with the following types of Modules:

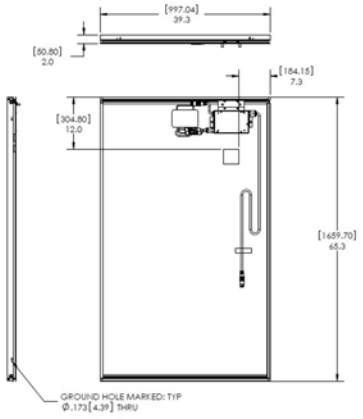
Instant Connect DC Module



Instant Connect AC Module
with M215 Micro-inverter



AC Module
with M190 Micro-inverter



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2.2: Required Site Information

Begin designing the site by completing a site survey:

- Project contact name, phone number, and email
- Project address
- Roof measurements, type, pitch, and azimuth
- Rafter type, size, and spacing
- Obstructions and shading
- Array layout and dimensions
- Fire setback and other local AHJ requirements
- Other important information such as design wind speed (MPH), exposure category, snow load, and seismic zone

2.3: Preliminary Design Layout

Before developing a design layout, be familiar with Andalay Solar panels unique parameters. As Andalay Solar panels are connected together, they form a rigid structure, and not single rows of panels on independent racking systems as with ordinary solar panels. The frames of Andalay Solar panels is where the “groove” is accessible and will serve as connection between the array and the chosen roof-mounting solution. The stainless steel Andalay Solar splices grounds and connects panels in the East-West direction serve as structural components. The stainless steel G-Bolt mechanically attaches and grounds the array in the North-South direction, and enables sharing of footings between the first and second rows (and all consecutive rows until the top of array). In an array layout, include a 1” gap between rows in North/South direction to accommodate the installation of North/South brackets.

Refer to the Technical Evaluation Report to determine maximum allowable anchor spacing. Panels which overhang the last footing in a row may stick out no more than a maximum of 16" from that footing. The completed design layout should include the plan layout, specification sheets, and BOM. For every project, the designer in charge must verify any structural engineering review requirements with local AHJ officials and obtain a professional structural engineering stamp (P.E.) if needed. Alternatively, Andalay Solar can provide engineering services and/or a P.E. stamp for wind and seismic calculations at an additional cost.

2.4: Thermal Expansion Considerations

For thermal expansion, include a 1” ‘gap for every more than 17 Modules (portrait) or every 10 Modules (landscape). For bigger configurations, you may place separate arrays next to each other to give the appearance of a single array, if desired.

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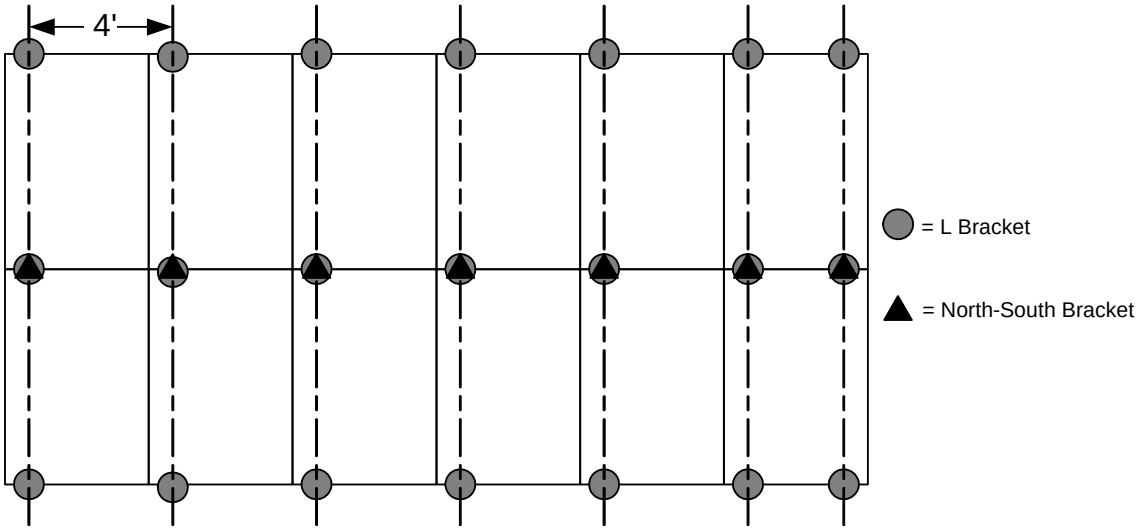
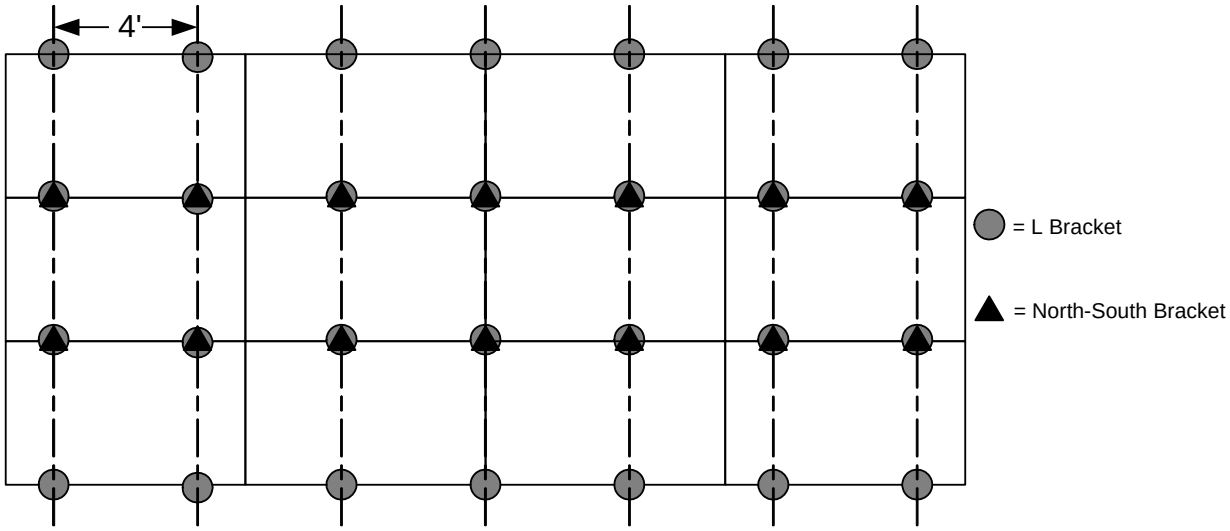
2.5: Module Orientation

Use portrait (vertical) orientation for AC Modules with either the M190 or M215 micro-inverter.



Use landscape (horizontal) orientation for DC Modules



2.6: Andalay Solar Instant Connect™ AC Modules

Instant Connect™ is a line of products from Andalay Solar that automates Module-to-Module grounding and wiring, making installing solar, faster, and easier than any other solution on the market. By integrating solar panel racking directly into the panel, Instant Connect technology integrates racking directly into the Module, enabling rapid, secure mounting of Modules on both flat and sloped roofs. THe patented frame design includes an innovative Splice system that automates all connections including:

- **Module-to-Module mechanical connections:** Joining each Module across a string.

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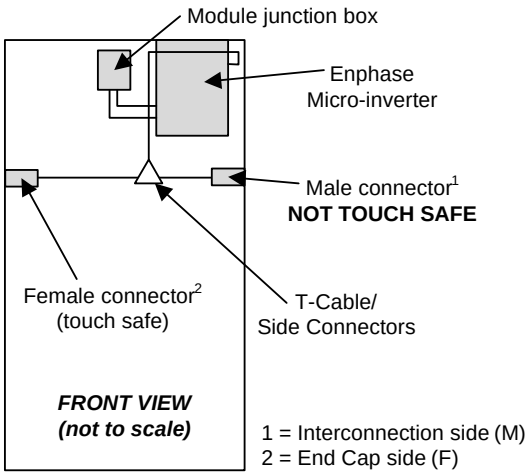
- **Module-to-Module grounding:** Provides a redundant, internal ground connection (U/L and NEC approved), thus removing an installation step and replacing expensive copper ground wire.
- **Module-to-Module electrical connections:** Wiring connections are automatic as Modules are joined together, removing the need to wire each panel and use cumbersome custom cabling.

2.6.1: Overview

This option is available for AC Modules equipped with the M215 Micro-inverter.

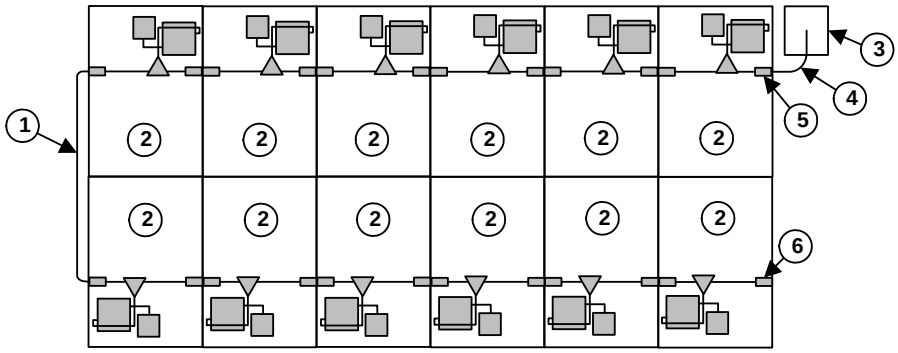
Familiarize yourself with Andalay Solar Instant Connect Modules before installing the array. Instant Connect Modules include UL-approved wiring, grounding, and electrical connections that include one male and female output connector per Module.



- At one end of the array, terminate each exposed male connectors in a junction box. The male side of the branch connects to an interconnect cable that in turn runs directly to the junction box at the head of the branch circuit.
- At the other end of the array, terminate each exposed female connector with an End Cap.

2.6.2: Wiring using Extension Cables

In most cases, you can simplify array wiring by rotating each row of Instant Connect Modules 180 degrees and using extension cables, as shown below.



1 = 8' Extension Cable
2 = Instant Connect AC Module
3 = Junction Box
4 = AC Interconnect Cable
5 = Male connector
6 = Female connector & End Cap

FRONT VIEW
(not to scale)

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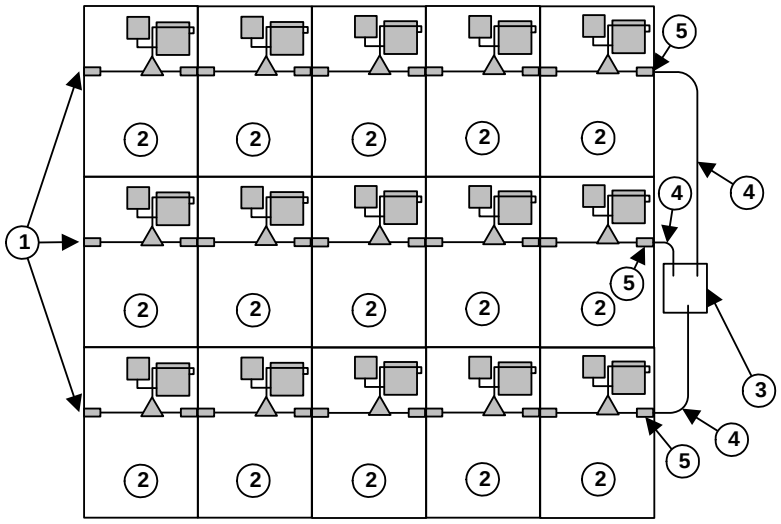
2.6.3: Wiring Using AC Interconnect Cables

If you opt not to rotate the Modules, be sure to terminate each female connector with an End Cap and use pigtails to connect each exposed male connector to a junction box, as shown below.



1 = Female connector & End Cap
2 = Instant Connect AC Module
3 = Junction Box
4 = AC Interconnect Cable
5 = Male connector

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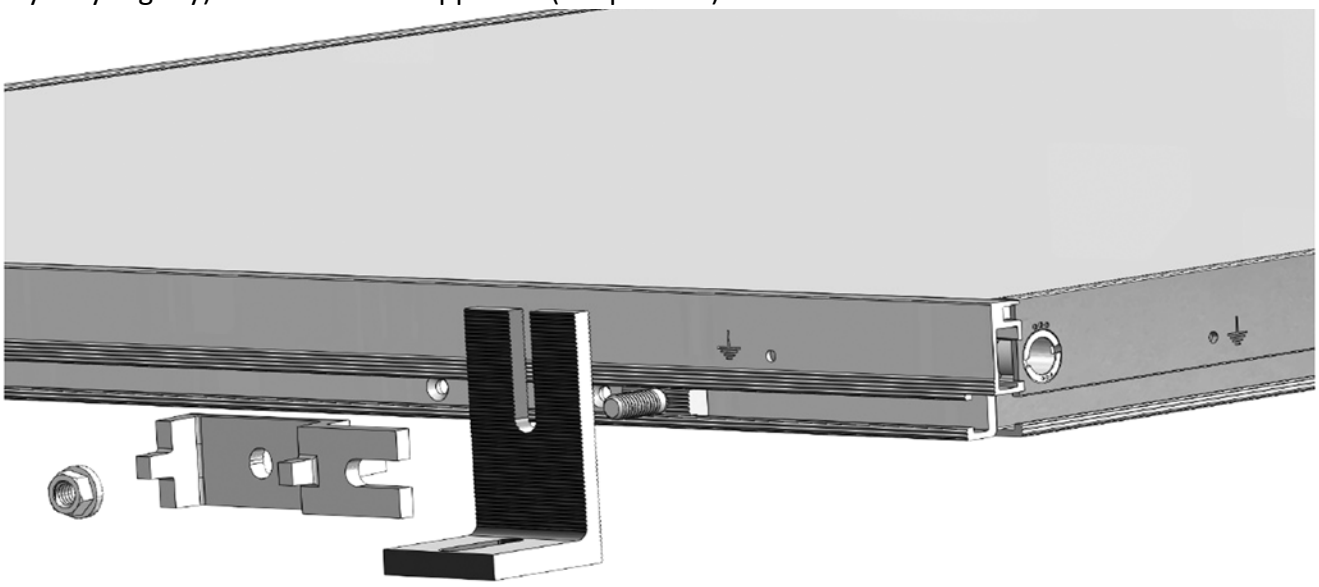
Chapter 3: Installation

This section explains how to install the Andalay Solar Sloped Roof Mounting System. Please see Chapter 1 for the full list of required parts, fasteners, and tools. For more information including photos, specification sheets, certifications, and Technical Evaluation Reports, visit Andalay Solar at http://www.Andalaysolar.com/index.php/dealer-resources.

CAUTION: CONSIDER THE WEIGHT AND PLACEMENT OF STAGED MATERIALS ON THE ROOF TO ENSURE ADEQUATE STRUCTURAL SUPPORT.

3.1: Overview

This rendering illustrates how the Andalay Solar Sloped Roof Mounting System assembles (actual parts may vary slightly). Please see the Appendix (Chapter 6.1) for additional roof attachment methods.



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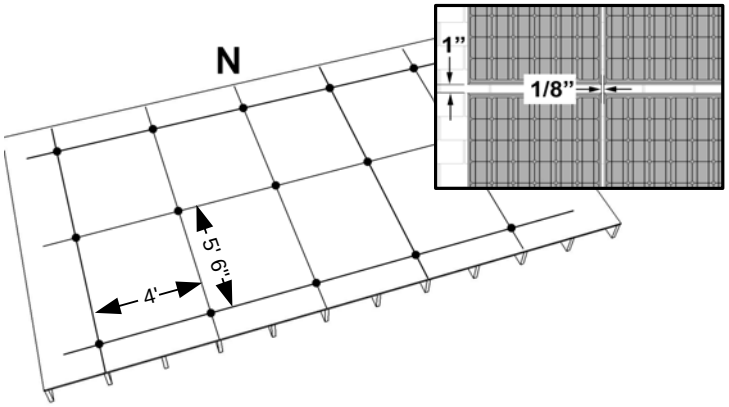
3.2: Layout the Array

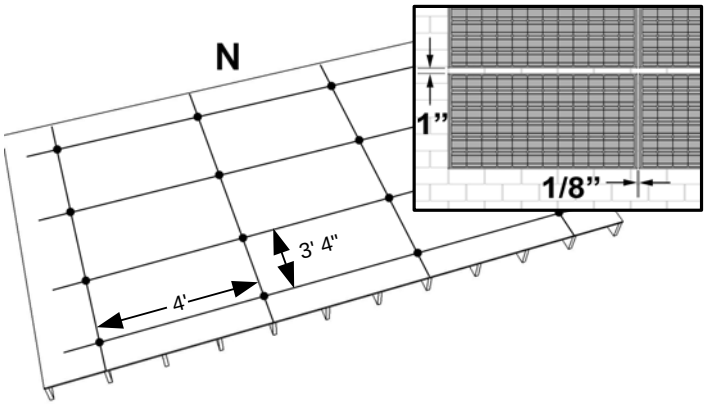
To lay out a PORTRAIT array:



Use a chalk line to lay out the array using the dimensions specified in the system design. North/South lines should be centered on rafters or other structural members if using penetrating roof components (see Section 3.3). Allow a 1" N/S gap and a 1/8" E/W gap between modules, as shown.

Note: This manual depicts a portrait installation; the procedure is the same for both landscape and portrait installations.

To lay out a LANDSCAPE array:

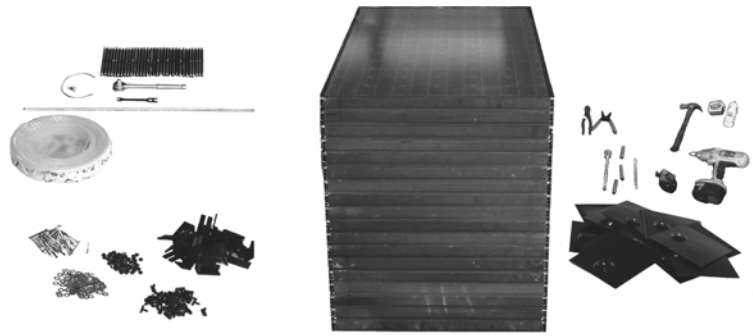


Use a chalk line to lay out the array using the dimensions specified in the system design. North/South lines should be centered on rafters or other structural members if using penetrating roof components (see Section 3.3). Allow a 1" N/A gap and a 1/8" E/W gap between modules, as shown.

Note: This manual depicts a portrait installation; the procedure is the same for both landscape and portrait installations.

3.3: Unpack and Verify Components

Unpack and stage the components.



Verify that you have the correct quantities of all required components before beginning the installation.

Note: See Section 6.2 for installation instructions on flat concrete/cement tiles, or S/barrel tiles.

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3.4: Install Flashings

Prepare the roof. (1

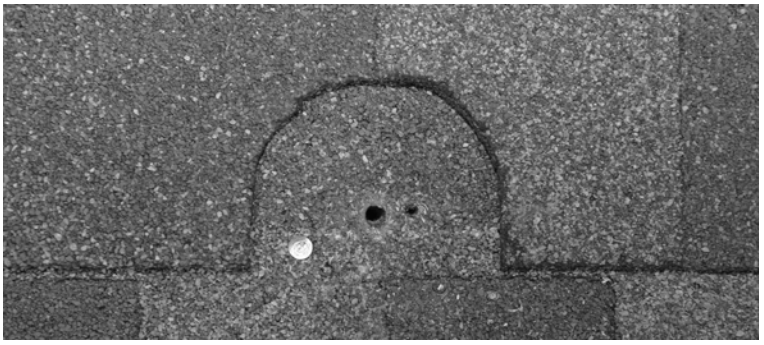
Lay out the roof as described in Section 3.2.

Cut the roofing as needed to accommodate the Flashing and then drill a pilot hole for the 5⁄16” Lag-Bolt.

Note: The Technical Evaluation Report lists minimum rafter penetration requirements.

Remove sawdust and other debris. (2

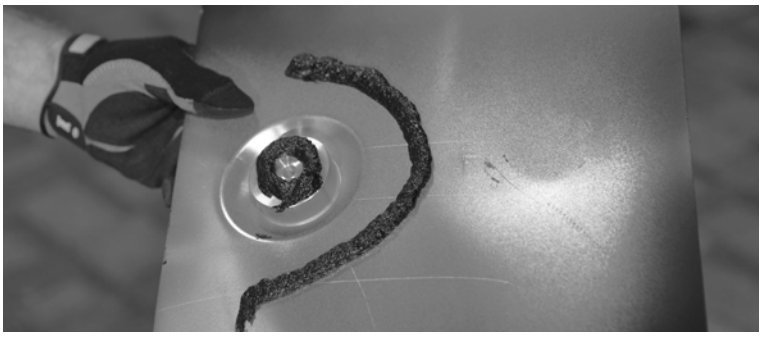
Loosen the composition shingle directly above the pre-drilled roof penetration. Make sure to remove any nails, staples, or debris that will interfere with the Composition Mount Flashing.



Apply roofing sealant to the Flashing. (3

Backfill the roof penetration applying a liberal amount of sealant to the immediate area.

Apply appropriately rated roofing sealant to the underside of the Flashing in accordance with manufacturer instructions..



Slide the Flashing under the overlapping shingles. (4

The bolt hole in the Flashing must align with the hole you drilled in Step 1.

Press the Flashing firmly against the roof once properly positioned to ensure a tight seal.

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3.5: Install L Brackets

1) Secure L Bracket to the roof.

Use one 5⁄16” Lag-Bolt and flat washer per L Bracket.

2) Tighten the Lag-Bolt using a power driver.

Tighten the Lag-Bolt until the head of the lag bolt is 1⁄8” from seating on the fender washer. The 1⁄8” gap allow installers to line up and adjust the L-bracket before tightening to final position.

3) Verify proper L Bracket installation.

Use a string to align a row of attachments. Torque the lag bolt to the L-bracket to 15-20 ft/lbs.

Note: Installed Flashing and L Bracket assemblies are called Standoffs.

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Install the remaining Standoffs. (4

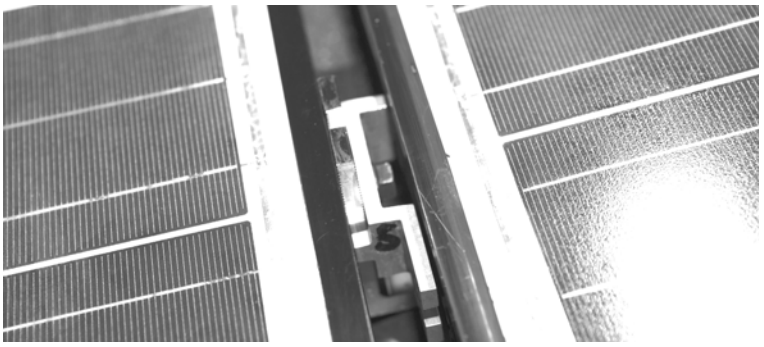
Repeat Sections 3.4 and 3.5 for each of the remaining Standoffs.

3.6: Install the First Module

Place Hex Bolts in Module channels. (1

Slide one Hex Bolt or G-Bolt into the Module C channel for each Standoff.

Note: Hex Bolts go into the channel on the short side of the Module for portrait installations; they go into the channel on the long side of the Module for landscape installations.



Lift the Module into position. (2

Lift the Module into position and slide the Hex Bolts or G-Bolts into the slots in the L-Brackets. Loosely thread a Hex Nut on each bolt.

The module will temporarily rest on the 3/8" hardware left loose, allowing installers to line-up and adjust the modules before tightening to final position.

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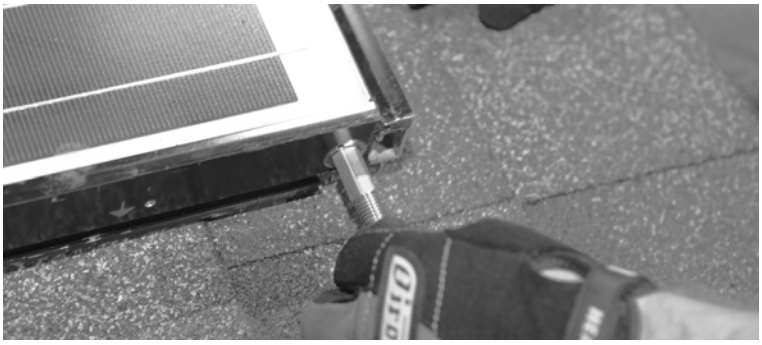
3) Insert LH Splice.

Insert a Splice (LH end) into the Module through the Splice insertion hole with the 3 dots above it.

Thread the Splice counter-clockwise into the Module approximately 1/2 turn.

4) Insert RH Splice.

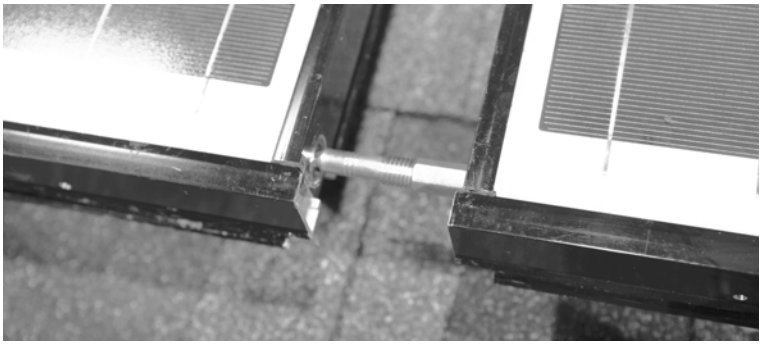


Insert a Splice (RH end) into the Module through the hole without any dots above it.

Thread the Splice into the Module approximately 1/2 turn.

3.7: Finish the First Row

3) Insert LH Splice.



Lift the next Module into position.

The Splices in the first Module should go into the holes in the next Module.

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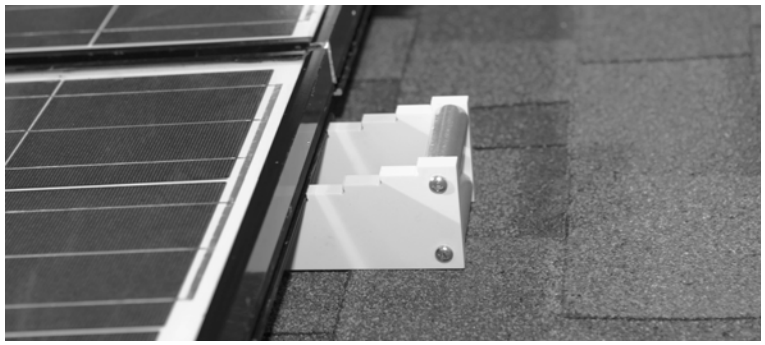
Level the Modules using a Step Block. (2

Place Step Blocks under the Modules as needed to level the Modules.

Lift the Module before inserting or adjusting a Step Block. Gently lower the Module onto the Step Block when ready.



Use a Splice Driver to tighten the Splices and secure the Module. (3

The hex end of a Splice fits into the socket at the end of the Splice Driver.

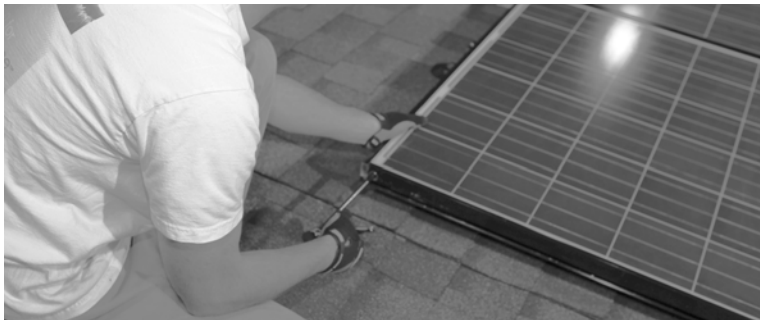
Attach a ratchet to the other end of the Splice Driver.

Note: Alternatively, you may use a Andalay Solar wrench between the Modules to tighten the Splices and skip both this step and Step 4. See Section 3.10.

Insert the Splice Driver into the holes in the Module. (4

The Splice Driver slides through the Module to engage with the Splices.

Torque the Splices to 5-7 foot-pounds. The front Splice tightens LH and the rear Splice tightens RH. Have a helper ensure that the Modules are tightening together.



Secure the Module to the Standoffs. (5

Use a level to align Modules, then torque to 15-20 ft/lbs. (for Hex Bolts), or 20-25 ft/lbs. (for G-Bolts).

You may remove the Step Blocks once the Modules are secure.

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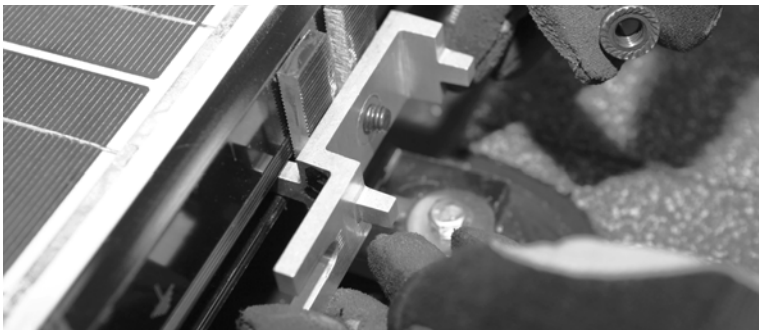
6) Repeat Steps 1-5 for the remaining Modules in the first row.

Secure the rest of the Modules in the current row to the array as described in Steps 1-5.

Proceed to Section 3.9 when you reach the end of the row.

3.8: Add the First Module of the Next Row

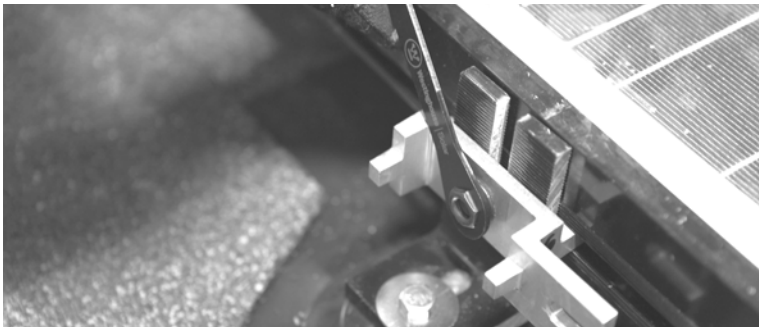
1) Add North/South Brackets.



Remove the Hex Nuts from the Hex Bolts or G-Bolts on the Standoffs between rows.

Add one North/South Bracket to each Standoff and then replace the Hex Nuts.

2) Secure the Hex Nuts.



Use a Andalay Solar wrench to loosely install the Hex Nuts.

Use a torque wrench to tighten the Hex Nuts to 15-20 foot-pounds.

3) Finish securing the Lag-Bolts to the first-row Standoffs.

Use a power driver to loosely install the Lag-Bolts securing the front-row Standoffs to the roof.

Use a torque wrench to tighten the Lag-Bolts to 15-20 foot-pounds.

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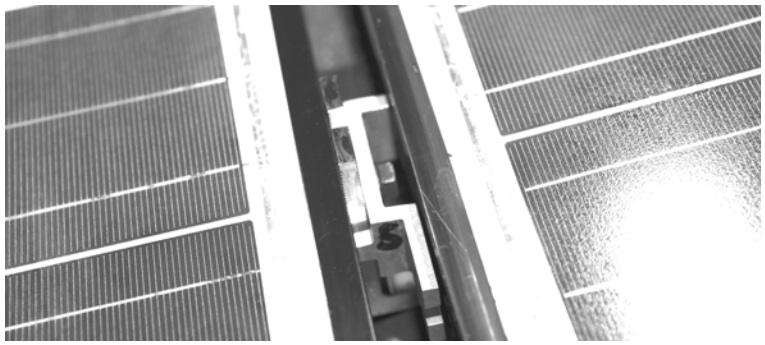
Add the first Module of the next row. (4

Slide upper row module into the ears of the North-South bracket from Step 1-3 of Section 3.9. Use step block to hold module in position.

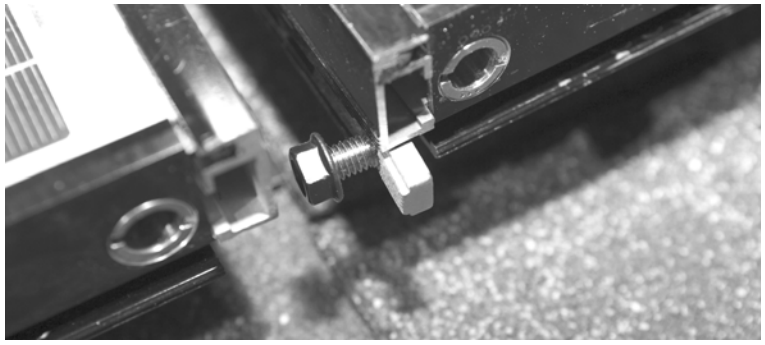


Add Hex Bolts or G-Bolts to the first Module of the next row. (5

Slide one Hex Bolt or G-Bolt into the C channel of next Module on the side facing the first row of Modules.

Add one Hex Nut to each Hex Bolt or G-Bolt and thread on about 1/2 turn.

Note: G-Bolts ground the array across rows to form a continuous grounding path.



Secure the Module to the North/South Brackets. (6

Align the Module.

Use a Andalay Solar wrench to loosely install the Hex Bolts or G-Bolts.

Use a torque wrench to tighten to 15-20 foot-pounds (Hex Bolts) or 20-25 foot-pounds (G-Bolts).

Position the Module on the upper Standoffs. (7

Slide the Hex Bolts or G-Bolts on the upper side of the Module into the slots in the Standoffs.

Use a Andalay Solar wrench to loosely install the Hex Bolts or G-Bolts. Use a torque wrench to tighten to 15-20 foot-pounds (Hex Bolts) or 20-25 foot-pounds (G-Bolts).

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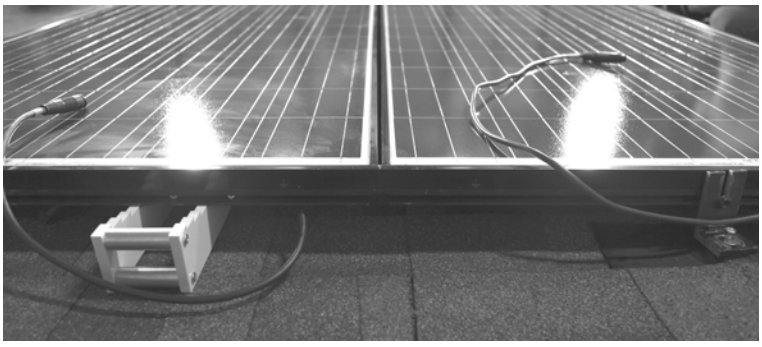
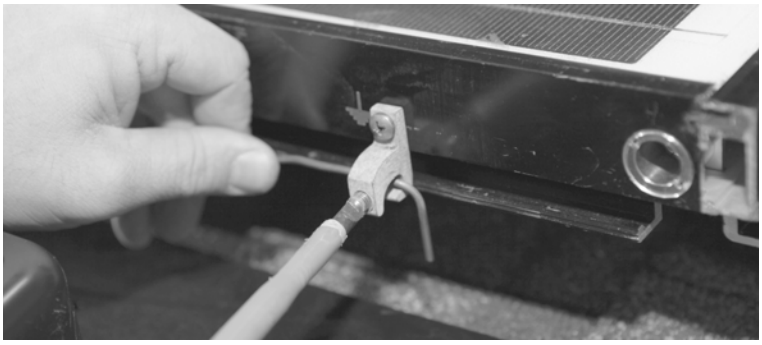
3.9: Completing the Rest of the Array

1) Install the remaining Modules in the array.



Repeat Steps 1-7 in Section 3.8 for the remaining Modules in the array.

2) Ground the Array.

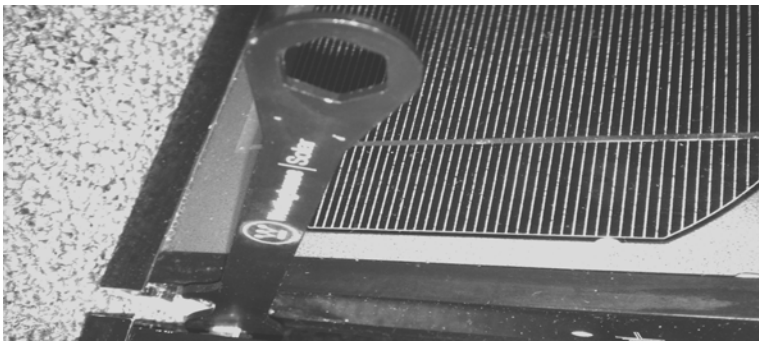


Attach a Grounding Conductor to the grounding hole in the outer edge of the first Module in each row, then connect a #6 solid bare copper grounding wire (or other gauge as required by local building codes) to the building ground as described in Section 4.3.

Note: If you used G-Bolt for inter-row attachments, then the Grounding Connector is only needed at the first Module of the first row to ground the array to the junction box.

3.10: Alternate Method of Securing Modules

You may use a Andalay Solar wrench instead of a Splice Driver to secure Modules.



As described in Steps 3 and 4 of Section 3.7, you may use a Andalay Solar wrench to secure Modules instead of a Splice Driver.

To do this, use the open end of the wrench to tighten the Splice. Rotate away from the Module to tighten, as shown.

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Chapter 4: Wiring

This chapter contains instructions for wiring Andalay Solar PV Modules. Find the type of Module being used in the system and wire it as you build the array.

4.1: DC Modules

Note: DC Modules install in landscape (horizontal) orientation only.

Andalay Solar DC Modules are designed to be self-wiring in each string. The first Module in each string connects to extension cables that typically lead to a combiner box. The last Module in each string can be reconfigured by attaching the two end MC-4 connectors together, thereby completing the string circuit. Secure extra cabling to the Module frames using Wire Management Clips.

CAUTION: MODULE WIRING IS ARRANGED FOR SERIES CONNECTIONS ONLY.

4.1.1: String Sizes

Determine string sizes based on the voltage limit window for the central inverter selected during the system design phase. (Most strings have a maximum of 14-16 Modules.)

Some system designs may require splitting one array row into more than one string. In this case, treat the last Module of the string in the same way as you would any other string end. Be sure not to connect that Module to the first Module in the next string. The positive (+) and negative (-) MC-4 connector ends should be attached for the last Module in the string.

4.1.2: Wiring Requirements

Always comply with the following wiring requirements:

- End-row extension wires must be type USE-2, USE-2/RHW-2, and PV Cable/PV Wire stranded. Route these wires to the main combiner box closest to the array using Wire Management Clips per the system design.

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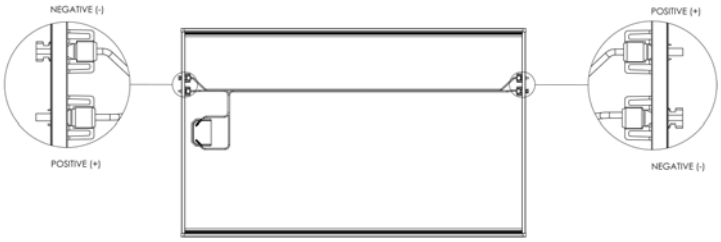
- Any other connections to Modules other than inter-Module connections must be done using two #12AWG type USE-2 sunlight-resistant output cables with male and female MC-4 connectors, or equivalent.
- Manage end-row cabling using approved wire-management products purchased separately.

CAUTION: ALWAYS FOLLOW SAFE WIRING PRACTICES TO AVOID SHOCK HAZARDS.

4.1.3: Wiring DC Modules

1) Use one pair of MC-4 Connectors between Modules.



Each pair of MC-4 Connectors joins two Modules together in series. Modules ship without the MC-4 Connectors inserted. Insert the Connectors before installing the Modules.

2) Note the locations of the Module electrical connections.

Wiring connections are at each end of the Module on the short side, for use in a land-scape (horizontal) installation.

3) Slide the next Module over the MC-4 Connectors.

As splices are tightened, MC-4 connectors will automatically connect. Verify that the MC-4 Connectors engage properly.

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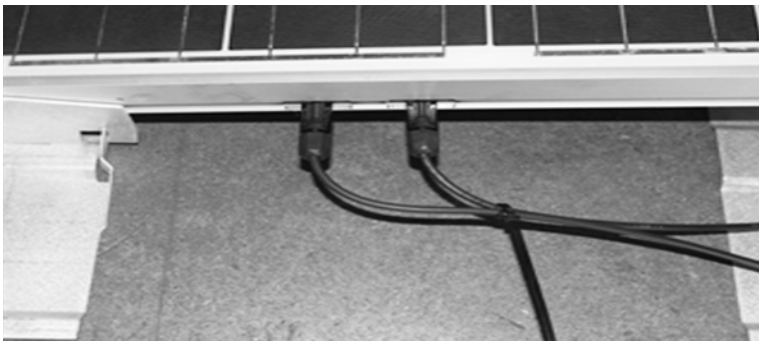
Connect the first and last Modules in each row. (4.	
The last Module at the end of each string is usually the last Module in the row. The positive (+) and negative (-) MC-4 connectors should be removed from the frame and connected together. Secure the connector to the inside of the frame. The first Module in a string must have two (2) extension cables plugged to the MC-4 wiring connections, as shown here.	

4.2: AC Module with M190 Micro-Inverter

Note: AC Modules install in portrait (vertical) orientation.

Andalay AC Modules come with integrated micro-inverters. Please refer to the micro-inverter documentation for more information. Please see the Appendix (Chapter 6.2) for sample 15, 30, and 40-Module wiring diagrams.

CAUTION: MODULE WIRING IS ARRANGED FOR PARALLEL BRANCH CONNECTIONS ONLY.

4.2.1: Branch Sizes

- Single-phase AC branch circuits using the Enphase M-190 micro-inverter can have a maximum of 15 micro-inverters; three-phase branch circuits can have a maximum of 21 micro-inverters.
- Protect each AC branch circuit with a 15A maximum breaker.
- The AC connectors are oppositely sexed so that multiple inverters can be connected to form one continuos AC branch circuit.
- The last Module at the end of each branch is usually the last Module in the row.
- Some system designs may require splitting one array row into more than one branch. In this case, treat the last Module of the branch in the same way as you would any other branch end. Be sure not to connect that Module to the first Module in the next branch.

Please refer to your inverter and Module documentation for further information and instructions.

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4.2.2: Wiring Requirements

Always comply with the following wiring requirements:

- End row extension cables must be type TC-ER with attached AC connectors provided by Andalay Solar. Route these cables to the junction box closest to each branch using wire management products per the current National Electrical Code (NEC) and Authority Having Jurisdiction (AHJ).
- All connections and other wiring must conform to the requirements specified in the Enphase documentation.
- Manage cabling using the Wire Management Clips as instructed in this manual. You may purchase Wire Management Clips from Andalay Solar.

CAUTION: ALWAYS FOLLOW SAFE WIRING PRACTICES TO AVOID SHOCK HAZARDS.

4.2.3: Wiring AC Modules with the M190 Micro-inverter

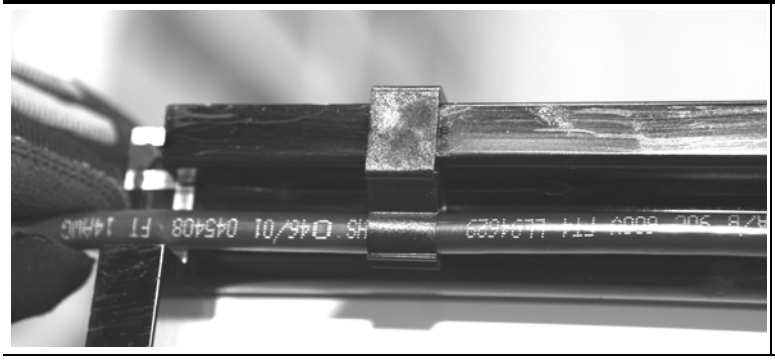
1) Connect the long tail (male) on the first Module to the short tail (female) on the next Module.

Push the connectors together until firmly seated.

2) Tighten the connection.

Twist the twist-lock knob until finger tight.

3) Manage the cables using Wire Clips.



Secure wires to the Module frames using Wire Management Clips as needed to prevent loose/dangling cables.

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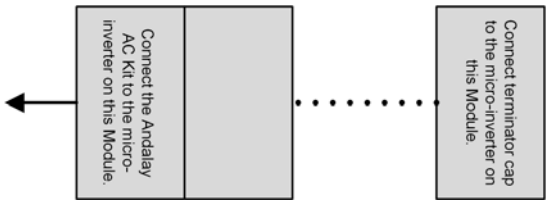
Connect the last Module to the home run that leads to the main panel. (4

Use the Andalay AC Kit to connect the branch of Modules to the system wiring.


Connect the Andalay AC Kit to the micro-inverter on this Module.
Connect terminator cap to the micro-inverter on this Module.

Add a Terminator Cap to the short tail of the last micro-inverter in the branch. (5

Screw Terminator Cap to the tail until finger tight. Do not over-tighten.

4.3: AC Module with M215 Micro-Inverter

Note: AC Modules install in portrait (vertical) orientation.

Andalay AC Modules come with integrated micro-inverters. Please refer to the micro-inverter documentation for more information. Please see the Appendix (Chapter 6.3) for sample 17, 34, and 75-Module wiring diagrams

CAUTION: MODULE WIRING IS ARRANGED FOR PARALLEL BRANCH CONNECTIONS ONLY.

4.3.1: Branch Sizes

- Single-phase AC branch circuits using the Enphase M-215 micro-inverter can have a maximum of 17 micro-inverters; three-phase branch circuits can have a maximum of 15 micro-inverters.
- Protect each AC branch circuit with either a two-pole 20A (maximum) circuit breaker on a 240V single phase system, or a three-pole 20 A (maximum) circuit breaker on a 208V three-phase system.
- Each module has a male and a female output connector. The male side of the branch connects to an interconnect cable that wires directly to the junction box at the head of the branch circuit. The female side of the branch is sealed with an End Cap.

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- The last Module at the end of each branch is usually the last Module in the row.
- Some system designs may require splitting one array row into more than one branch. In this case, treat the last Module of the branch in the same way as you would any other branch end. Be sure not to connect that Module to the first Module in the next branch.

Please refer to your inverter and Module documentation for further information and instructions.

4.3.2: Wiring Requirements

The Enphase M215 micro-inverter is self-switching from 240V and 208V. Accessory cables for the Instant Connect AC Module are not self-switching. Be sure to verify utility voltage, frequency, and whether the utility is single or three phase, and wire accordingly. Wires are colored as follows:

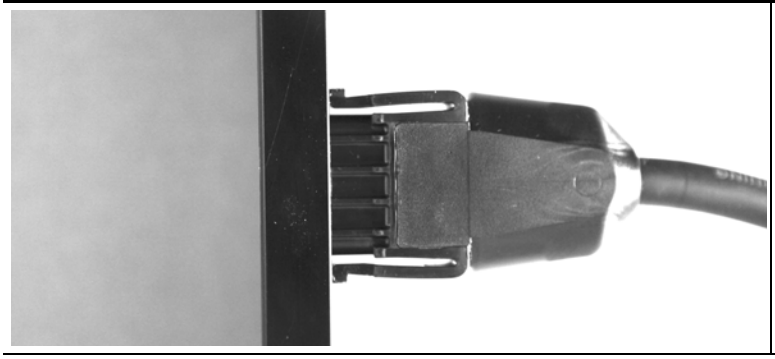
- Black: L1
- Red: L2
- White: Neutral
- Green: Ground

Always comply with the following wiring requirements:

- End row extension cables must be type TC-ER rated to 90 degrees C wet or dry. Route these cables to the junction box closest to each branch using wire management products per the current National Electrical Code (NEC) and Authority Having Jurisdiction (AHJ). Add an AC disconnect, per NEC and AHJ requirements.
- All connections and other wiring must conform to the requirements specified in the Enphase documentation.
- Manage cabling using the Wire Management Clips as instructed in this manual. You may purchase Wire Management Clips from Andalay Solar.

CAUTION: ALWAYS FOLLOW SAFE WIRING PRACTICES TO AVOID SHOCK HAZARDS.

4.3.3: Wiring AC Modules with the M215 Micro-inverter

1) Unpack the Module and engage the side connector cables.	
	Instant-connect Modules come packaged with side connectors installed at the first detent only. Before installation, insert the side connectors into the fully engaged position.

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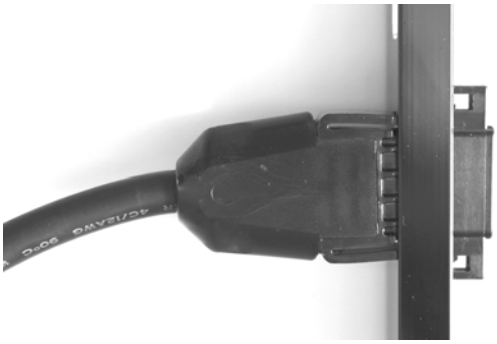
Tighten Splices to automatically connect the side connectors. (2

Male and female side connectors in the Modules automatically connect as you connect the Splices. Check to make sure that all connectors are fully engaged.

Note: This image shows the back of the Module to show the wire connections.

Add an End Cap to the female connector. (3

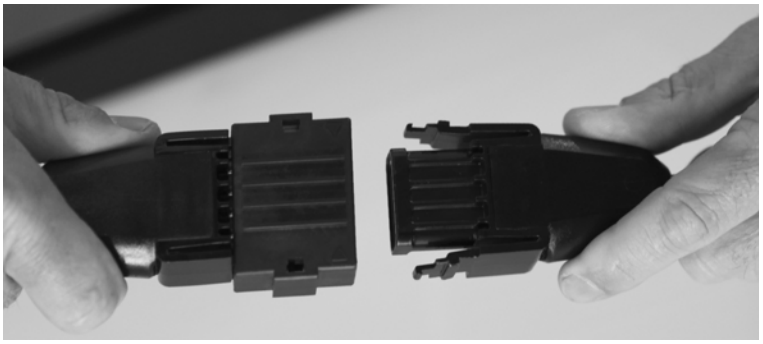
Add a sealing End Cap to the female-side connector at the end of a branch. This will usually be the last Module of a branch.



Connect an Interconnect Cable to the male connector. (4

At the beginning of a branch (usually the first Module of a branch), remove the male side connector from the frame to connect to an Interconnection Cable.

WARNING: THE MALE CONNECTOR IS NOT TOUCH-SAFE. IT MAY BE LIVE WHEN THE UTILITY ENERGIZES THE SYSTEM. ALWAYS TERMINATE THE INTERCONNECT CABLE IN A JUNCTION BOX.



Wire to the next row using an Extension Cable. (5

Rotate module orientation 180 degrees for alternating rows as seen in Section 2.6.2 and wire using extension cables.

Note: Remove the female and male side connectors from the Module frame to attach to the Extension Cable.

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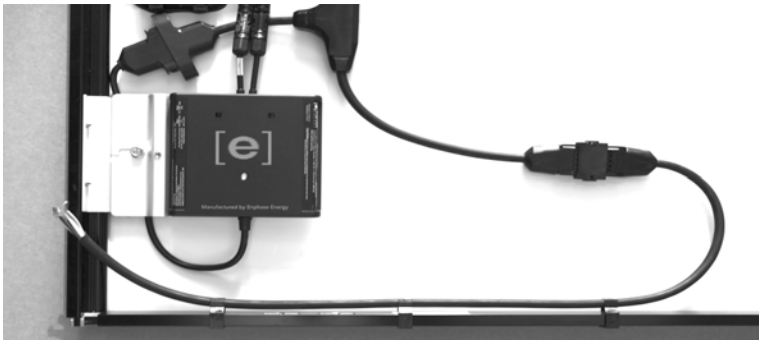
Manage the cables using Wire Management Clips. (6



Secure cables to the module frames using Wire Management Clips as needed to prevent loose/dangling cables.

4.4: Mixed M190/M215 Branches

When mixing M215s with M190s on a common circuit, make sure not to exceed the ratings of the cables or micro-inverter. The M190s are rated at 15A; the combined micro-inverters should not produce more than 12A (15A / 1.25), and should be protected by a 15A double-pole circuit breaker.

4.5: Lightning Surge Suppression

The Enphase warranty specifically excludes “acts of God,” such as lightning strikes. Enphase M190 and M215 micro-inverters include integrated surge protection that exceeds most traditional inverters; however, a surge of sufficient energy can overload this built-in protection and damage the equipment.

Lightning can strike anywhere, and need not strike the PV equipment or building directly to cause damage; nearby strikes can cause damaging voltage spikes. It is therefore best practice to install surge suppression on any solar installation. The *Enphase Installation and Operation Manual* with recommended lightning protection can be downloaded from:

http://enphase.com/wp-uploads/enphase.com/2011/06/Enphase_M215_InstallationOperation_Manual.pdf

4.6: Junction Boxes

1) Install wiring boxes on the roof.

Secure the boxes to the roof in accordance with manufacturer instructions.

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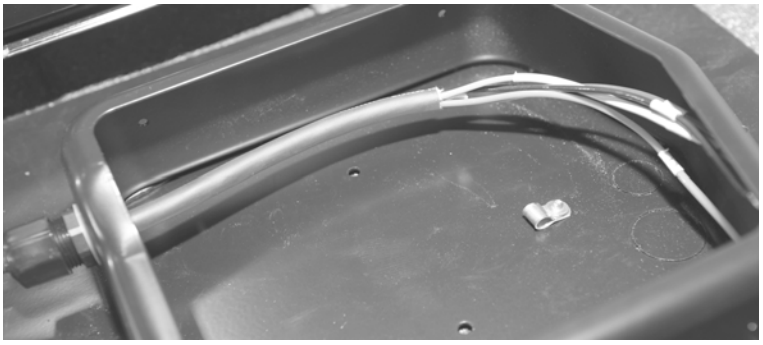
Prepare the wiring boxes to accept the wiring and strain relief. (2)	
Make an opening in the wiring box of sufficient size to allow installation of the Module wiring and strain relief. Fasten the strain relief to the wiring box.	
Insert the end of the Andalay AC Kit into the box. (3	
Pass the Andalay AC Kit through the strain relief into the box. Do not wire the system to the main panel until the entire array has been grounded. See Section 4.3.	

4.7: Grounding the Array

Array rows are grounded using Splices and G-Bolts. Proper grounding is achieved by assembling the Module frame(s) contiguously, using two bonding splices in the East-West direction. In the North-South direction, a stainless steel G-bolt secures to the Module frame using sharp edges designed to cut through the anodized coating.

At the end of the system array, a Grounding Conductor attaches to the Module frame through one of the 0.173" diameter (4.4 mm) holes on the Module frame marked with the "ground" symbol. Use an ILSCO GBL4 DBT lug, Star Washer, and self-tapping 10-32 X ½" Taptite II stainless steel screw torqued to 20 foot-pounds. The grounding wire used must be a solid copper from AWG 4-12 (#6 recommended, or as required by local codes). Splices between the Modules ensure that a continuous path for grounding across each array row is maintained in accordance with Section 690.43 of the National Electric Code (NEC).

There are two ways to ground the array:

1. Inter-Module bonding via East-West Splices. To ensure proper bonding, fully thread each Splice into its adjacent Module, and then torque to 5-7 foot-pounds.

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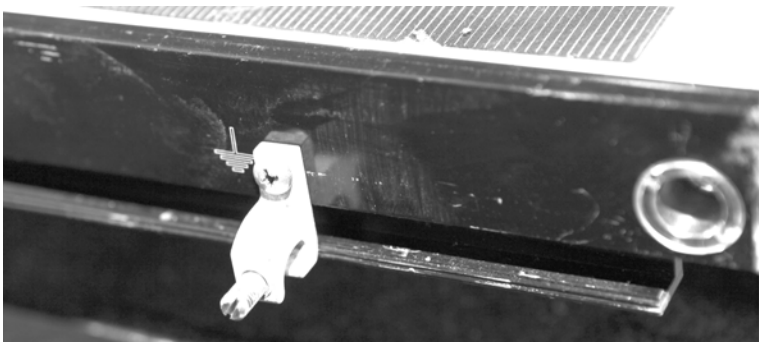
2. Inter-row bonding in the North-South direction using G-Bolt assembly. Follow Steps 1-6 in Section 3.8 when using G-Bolts. G-Bolts eliminate the need to install a Grounding Conductor and copper wire between rows.

4.7.1: Grounding the Array to the Junction Box

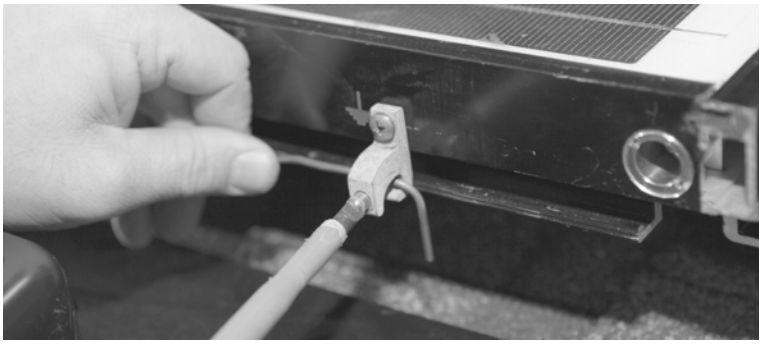
1) Attach a Grounding Conductor to the Module at the end of the system array.



Attach a Grounding Lug to the Module at the end of the system array. Fasten the Grounding Lug to a hole on the Module frame that is marked with the “ground” symbol.

Use 10-32 X ½” Taptite II stainless steel screw torqued to 20 inch-pounds.

4) Wire the Grounding Lug.



Insert a solid copper grounding wire into the Grounding Lug and torque to 20 inch-pounds.

3) Run the grounding wire to the junction box.

Insert grounding wire into the box and attach it to the ground bar.

Connect the grounding bar to the building ground in accordance with all applicable building codes.

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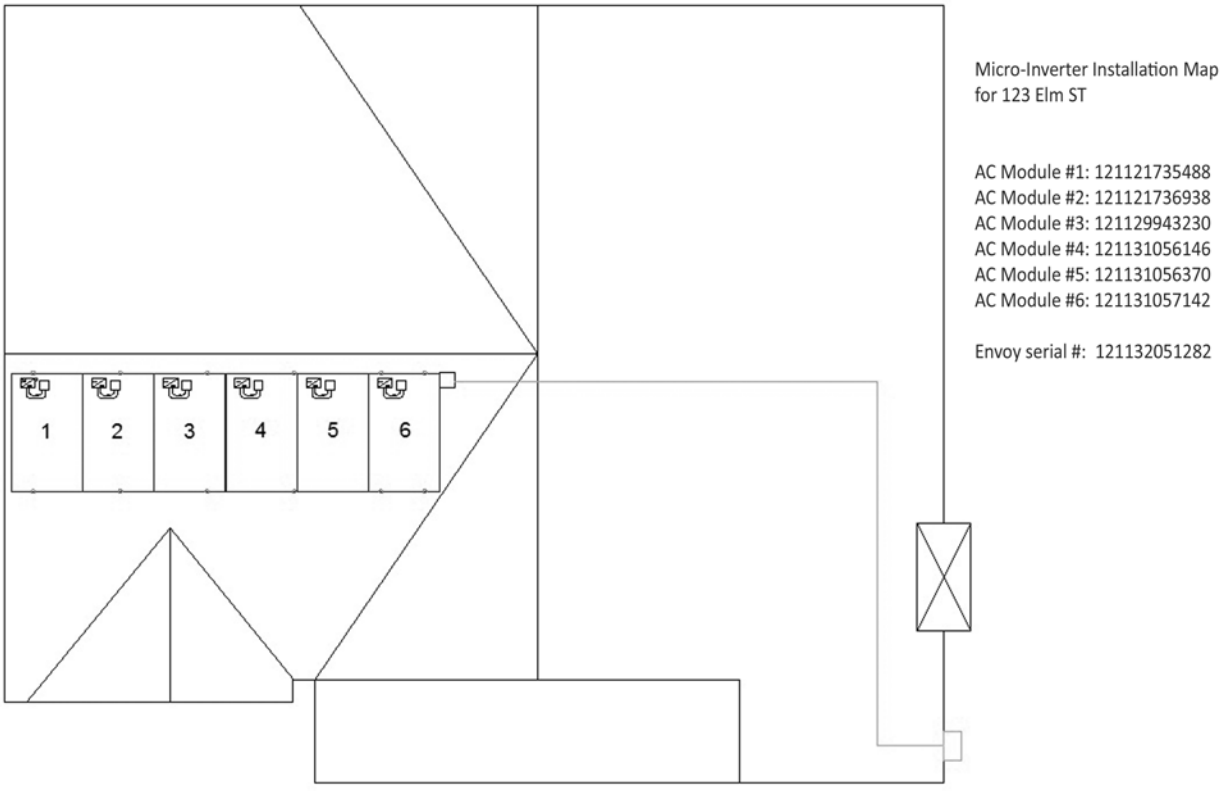
Wire the array to the main panel. (3	
The array may be wired to the main building panel once all Modules are grounded and wired to the roof boxes as described in Sections 4.2 and 4.3.	

4.8: Micro-inverter Installation Map

You should always create a Micro-inverter Installation Map to record the location of each micro-inverter in the array. The micro-inverter installation Map is a diagrammatic representation of the physical location of each micro-inverter in a Andalay Solar AC installation, such as the following example:



Note: The optional Enphase Envoy connects to every AC Module to the Internet to monitor the system. Follow the Monitoring Quickstart Guide to complete the Micro-inverter Installation Map.

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Each micro-inverter has a sticker with its unique serial number, as does the Enphase Envoy unit (for example, 121121735488). This sticker is conveniently placed at the top of each AC Module. Peel the sticker from AC Module and place it on the Inverter Installation Map.

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Chapter 5: Servicing

This chapter contains maintenance information for the Andalay Solar Sloped Roof Mounting System and instructions for removing a Module or Micro-inverter for servicing or replacement.

5.1: Maintenance Considerations

- Normal rainfall is usually sufficient to keep the glass Module surfaces clean. If excessive dirt builds up on the Modules, gently clean the Modules using a soft cloth with water and a mild detergent.
- Cleaning with ordinary tap water may create mineral scaling on the Module glass, which can be removed with commercial scale remover cleaners.
- Check the general condition of the array, Modules, wiring, and mounting hardware annually. This check should be performed by qualified personnel.
- Always use the correct tools during maintenance operations to avoid damaging the solar system.
- Always use replacement parts and hardware from Andalay Solar to ensure full system functionality and efficiency.
- Always follow the instructions in the following section when removing a Module from the array.

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5.2: Removing a Module

Always tag out all breakers, fuse panels, and disconnections to prevent accidental energizing and possible injury or death. Follow all of the safety precautions in Section 1.6 when servicing Modules.

CAUTION: NEVER ATTEMPT ANY SERVICING OR REPAIR ON AN ENERGIZED ARRAY AS THIS COULD CAUSE SERIOUS INJURY OR DEATH.

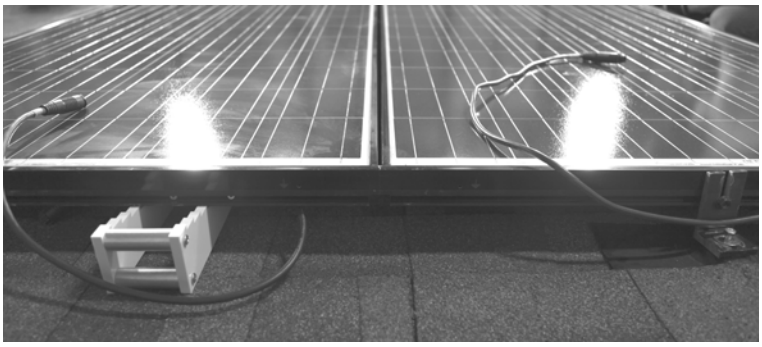
1) Disconnect all wiring from the row with the Module being serviced.

For DC Instant Connect Module, disconnect the MC4 connectors to the Junction Box.

For AC Instant Connect Modules, disconnect the interconnect cable to Junction Box.

For the AC Module, disconnect the Andalay AC Kit to the Junction Box.

2) Remove all of the Modules from the row(s) above the Module being serviced.



Follow the instructions in Sections 3.10 and 3.9 in reverse order. You must remove all Modules in all rows above the Module being serviced.

3) Remove the Modules in the row containing the Module being serviced.

Follow the instructions in Section 3.8 in reverse order to remove all of the Modules in the row being serviced until you have removed the Module that requires service.

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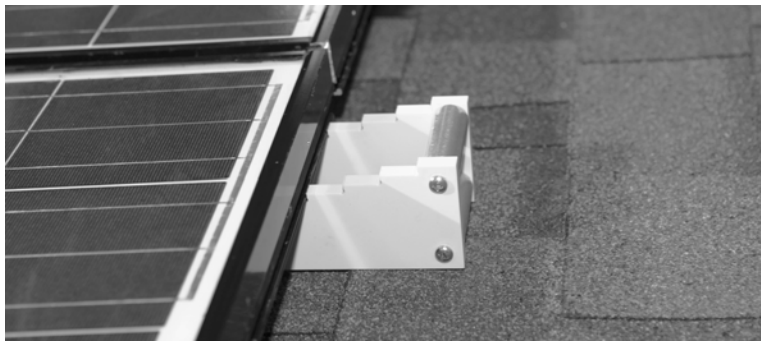
Replace the defective Module with a new Module. (4	
Follow the instructions in Sections 3.6 or 3.7 as appropriate to replace the Module.	
Reassemble the array. (5	
Reassemble the array, following the directions in Chapter 3, as appropriate. Be sure to restore the electrical connections and any removed grounding connections as described in Chapter 4.	

5.3: Removing a Micro-Inverter

Only Andalay Solar personnel are authorized to remove and replace micro-inverters at a certified service center. Attempting to service a micro-inverter in the field will void the AC Module's CSA certification. If this happens, the Module will then be treated as a certified DC Module with a separate certified micro-inverter attached to it. In this situation, the micro-inverter must have a DC grounding electrode conductor attached to the micro-inverter grounding lug, and this grounding electrode conductor must meet NEC requirements (including those in Articles 250 and 690) for size, routing, and splicing.

To ensure proper grounding from the Module frame to the micro-inverter after replacing the micro-inverter, attach a Grounding Lug to the Module as shown in Step 3 of Section 4.6, and then route an equipment-grounding conductor to the micro-inverter chassis. Please refer to the Enphase User Manual for installation instructions and recommended torque specifications.

Note: You need only remove the affected Module from the array to service or replace its micro-inverter.

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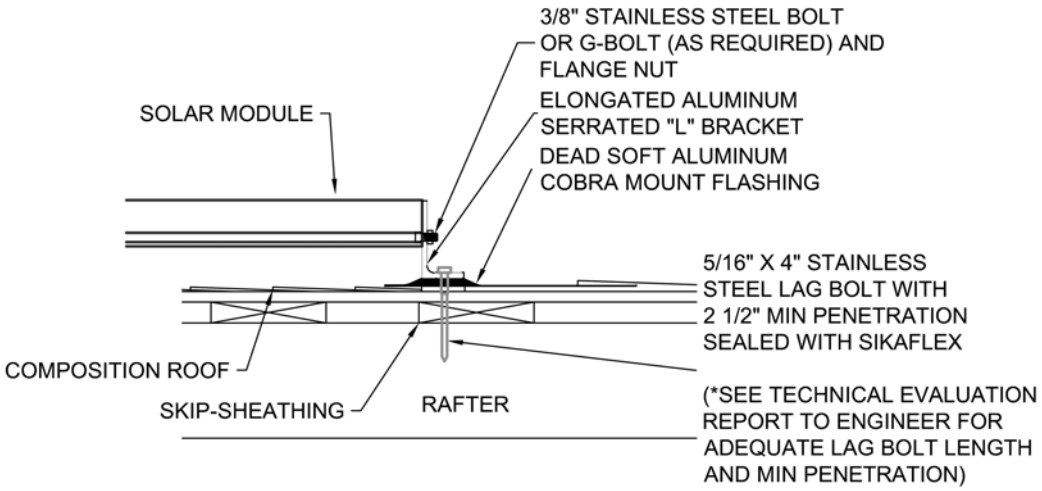
Chapter 6: Appendix

This Appendix contains installation diagrams for various roof types, as well as sample wiring diagrams.

6.1: Roof Types

6.1.1: Comp Shingle



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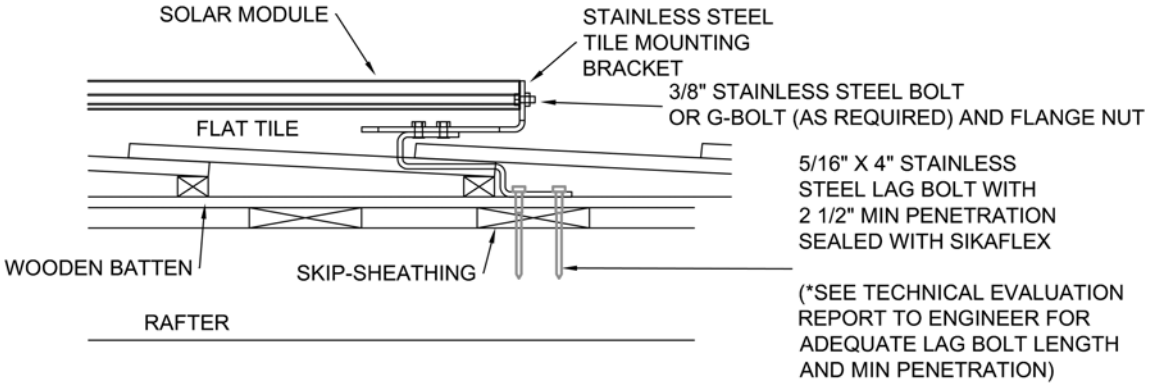
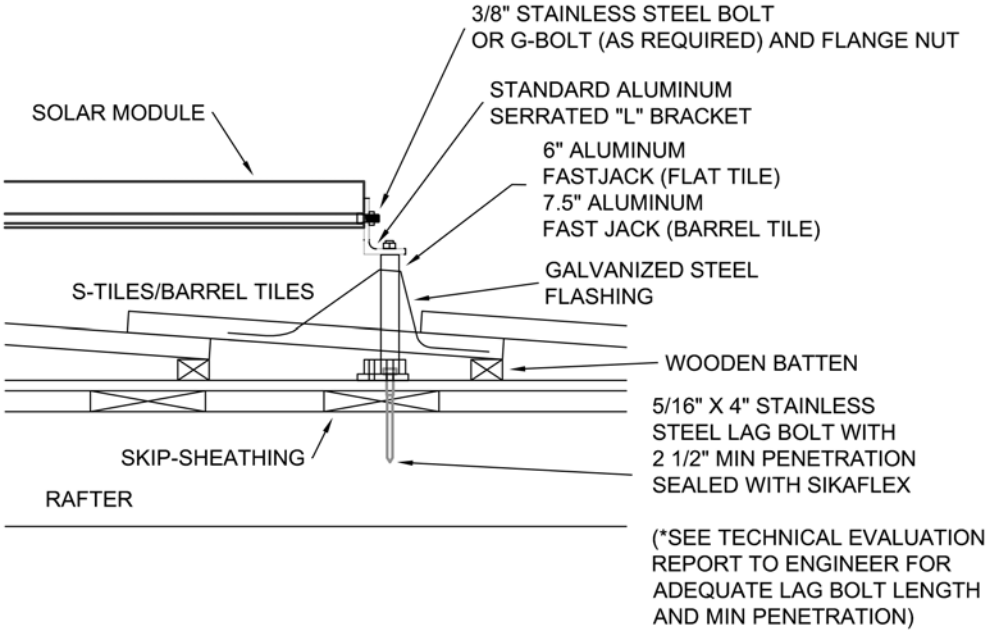
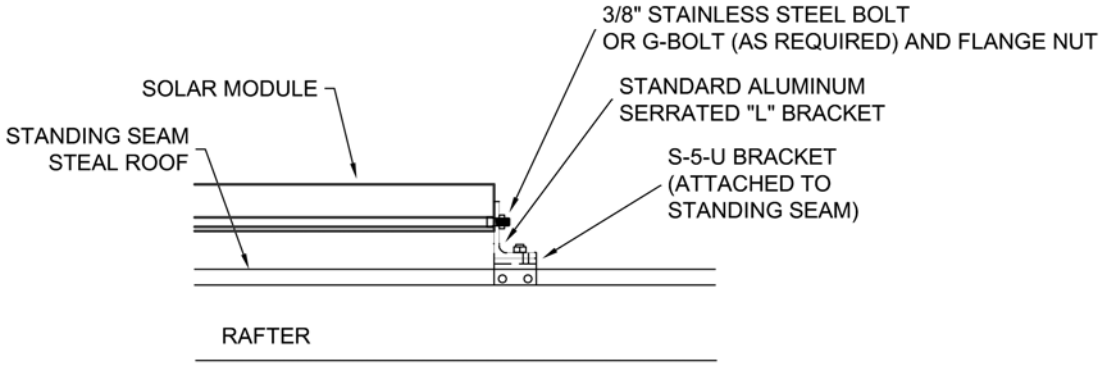
6.1.2: Flat Tile



6.1.3: S-Barrel Tile



6.1.4: Standing Seam



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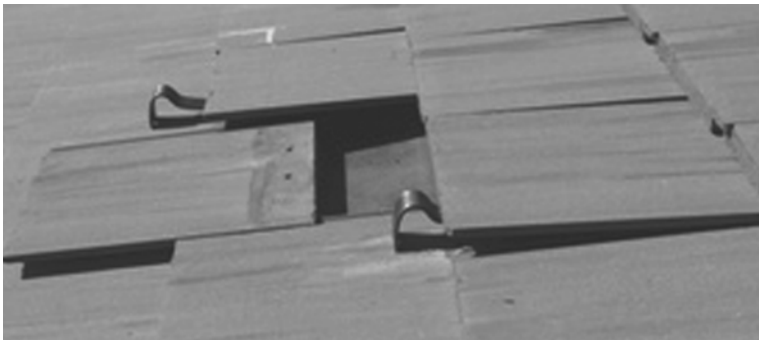
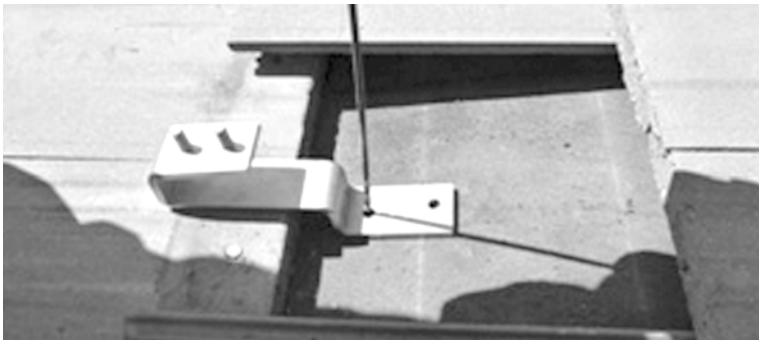
6.2: Supplemental Installation Instructions

6.2.1: Flat Concrete or Cement Tiles

Remove tiles. (1
Remove the tiles at each attachment point. Verify that Flat Tile Brackets will install directly above rafters.



Predrill bracket mounting holes. (2
Use a Flat Tile Bracket as a template to ensure accurate hole placement. ***WARNING: THE SPINNING DRILL BIT CAN MOVE OR EJECT THE FLAT TILE BRACKET. MAKE SURE THE BRACKET CANNOT MOVE BEFORE DRILLING THE HOLES.***



Fill the holes with roofing sealant. (3
Completely fill the holes with appropriately rated roofing sealant.

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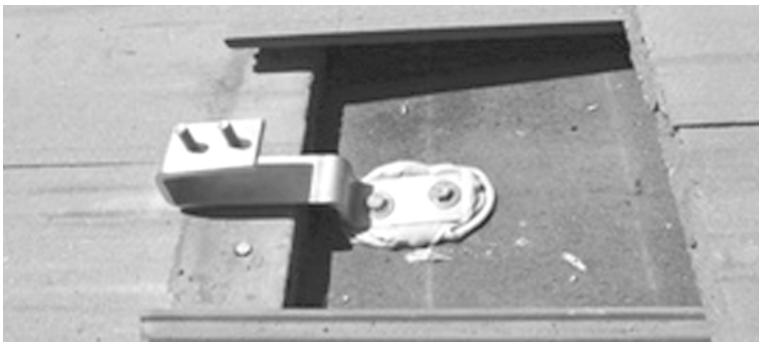
4) Secure the Flat Tile Brackets to the roof.

Use one Lag-Bolt and washer for each hole.

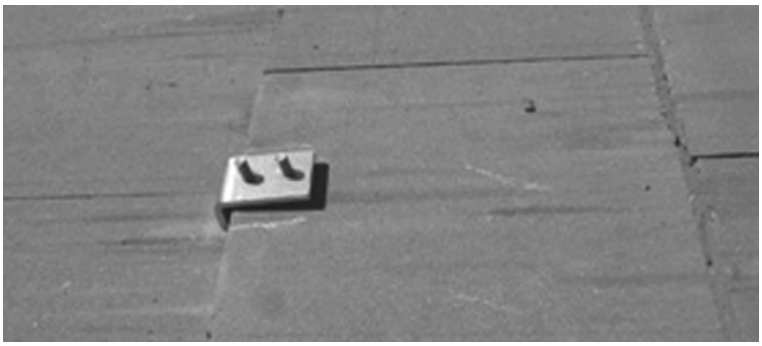
Torque Lag-Bolts to 15-20 foot-pounds.

5) Verify that each Flat Tile Bracket has been properly installed.



Verify that all Flat Tile Brackets have been properly installed and that all Lag-Bolts have been properly torqued.

6) Replace the tiles



Replace the roof tiles according to manufacturer instructions and local building codes.

Go to Section 3.6 for instructions on completing the installation.

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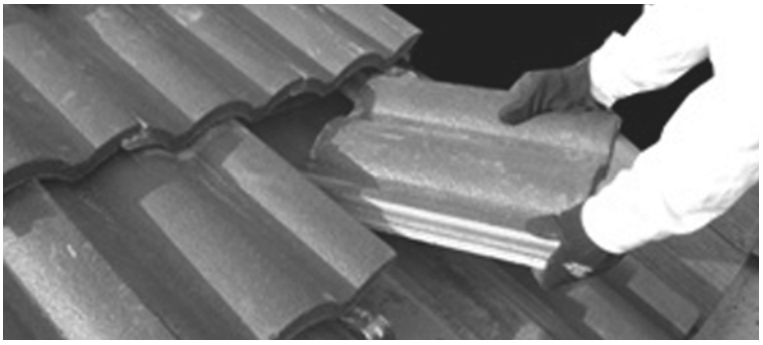
6.2.2: S or Barrel Tiles

Remove tiles. (1

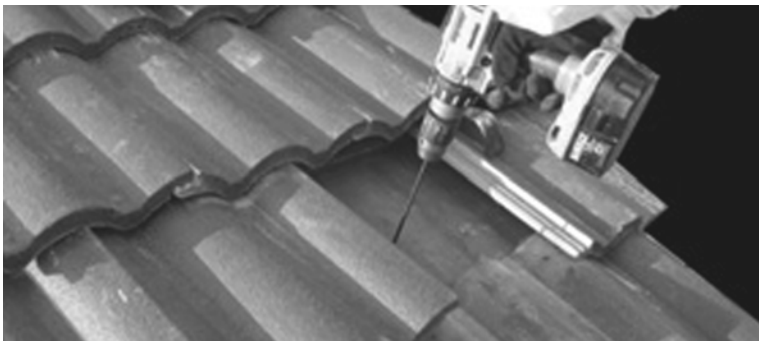
Remove the tiles at each attachment point.

Verify that Standoff Bases will install directly above rafters.



Predrill Standoff Base mounting holes. (2

Verify that each hole is properly located.



Fill the holes with roofing sealant. (3

Completely fill the holes with appropriately rated roofing sealant.

Place Standoff Base. (4)

Place a Standoff Base above each hole.

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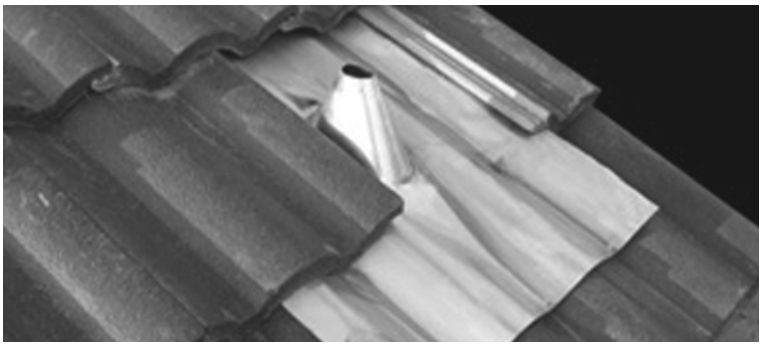
5) Secure Standoff Bases to the roof.

Use one Lag-Bolt and washer for each Standoff Base.

6) Torque all Lag-Bolts

Torque Lag-Bolts to 15-20 foot-pounds.

7) Prepare Flashings



Use one Flashing per Standoff location.

Mold each Flashing to the shape of the roof at its designated location.

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Install Standoffs. (8	
Insert one Standoff into each Flashing.	
Seal Standoffs to Flashings. (9	
Use appropriately rated vinyl roof tape to seal each Standoff to the Flashing.	
Assemble Module attachment hardware. (10	
Loosely assemble Module attachment hardware. Go to Section 3.6 for instructions on completing the installation.	

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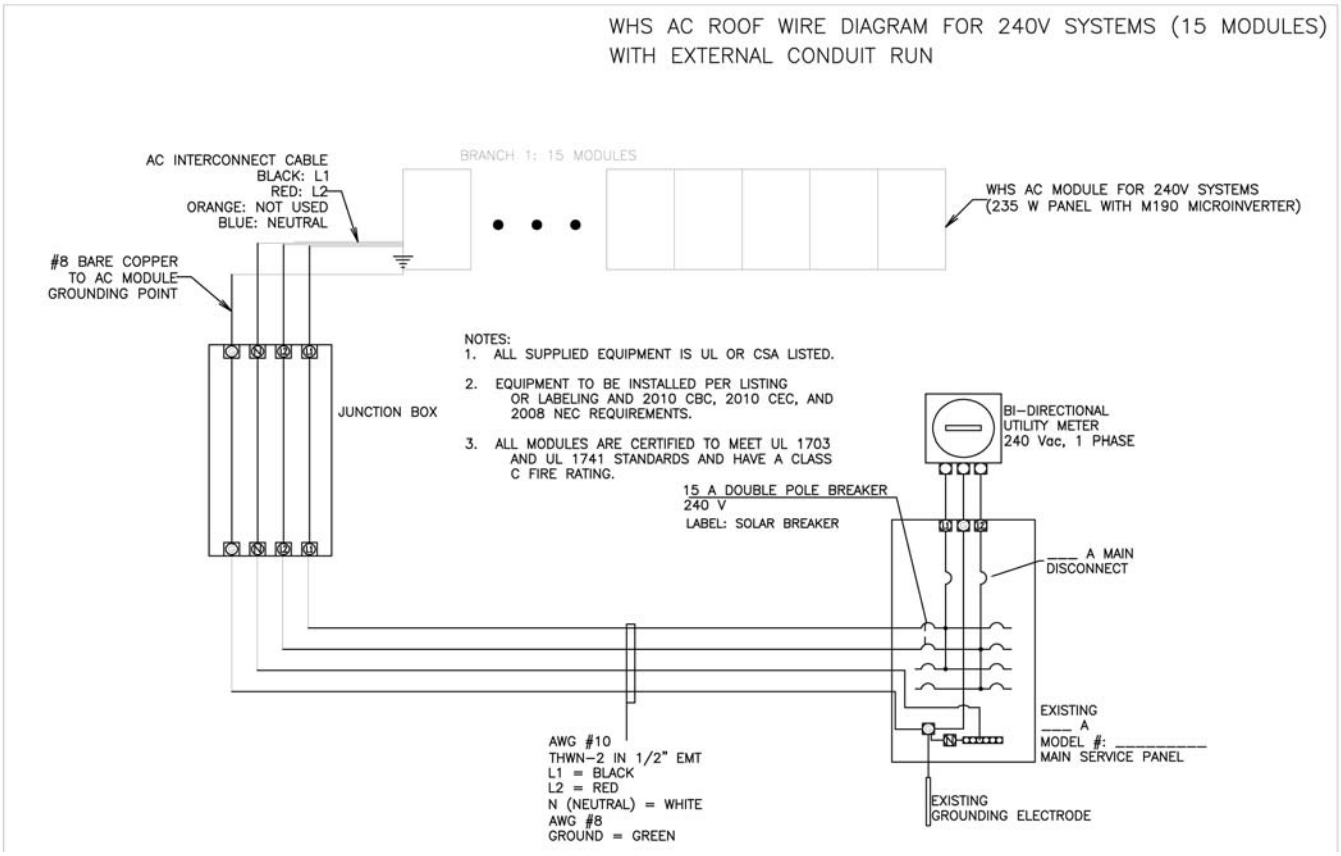
6.3: M190 Wiring Diagrams

6.3.1: 15 Modules



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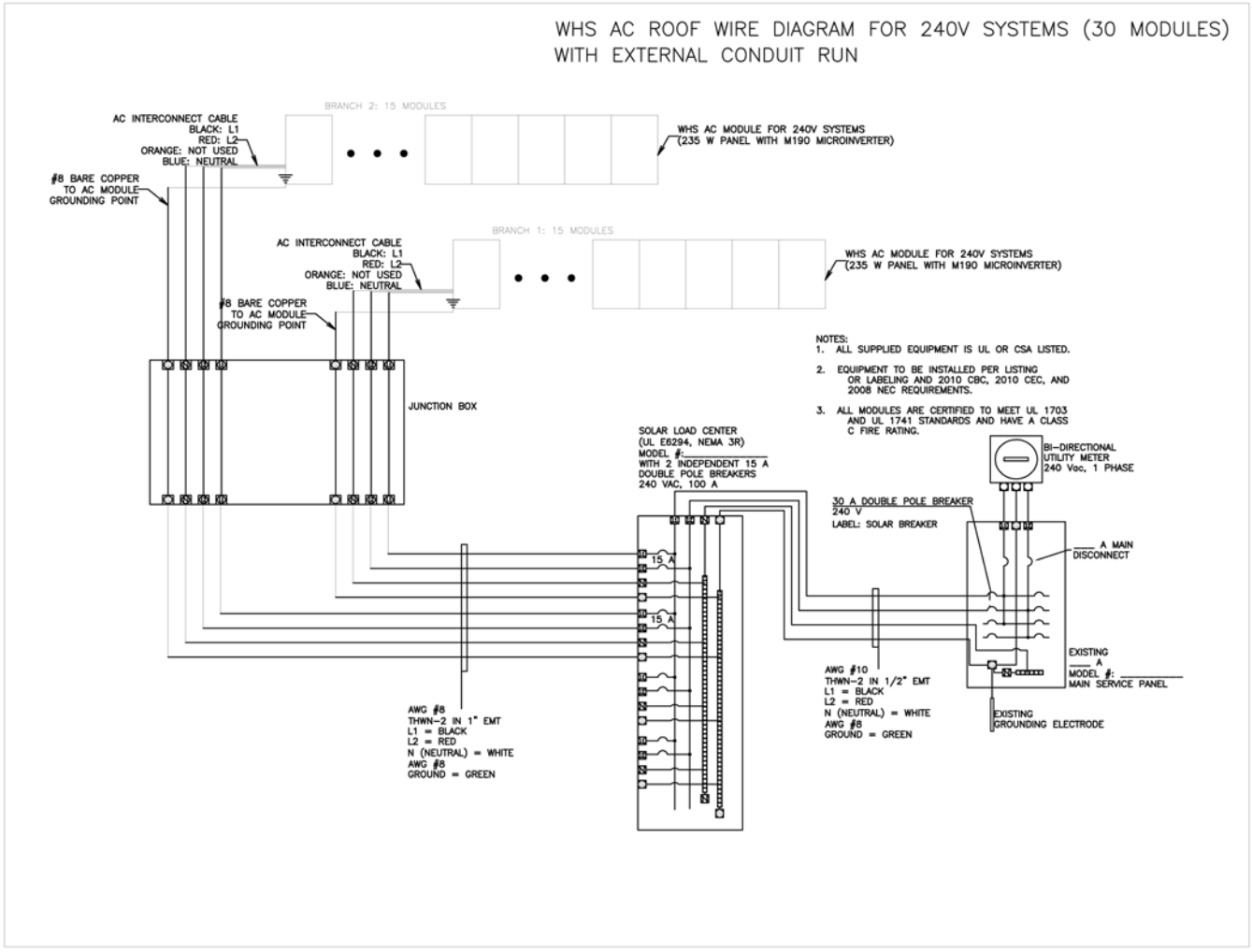
6.3.2: 30 Modules



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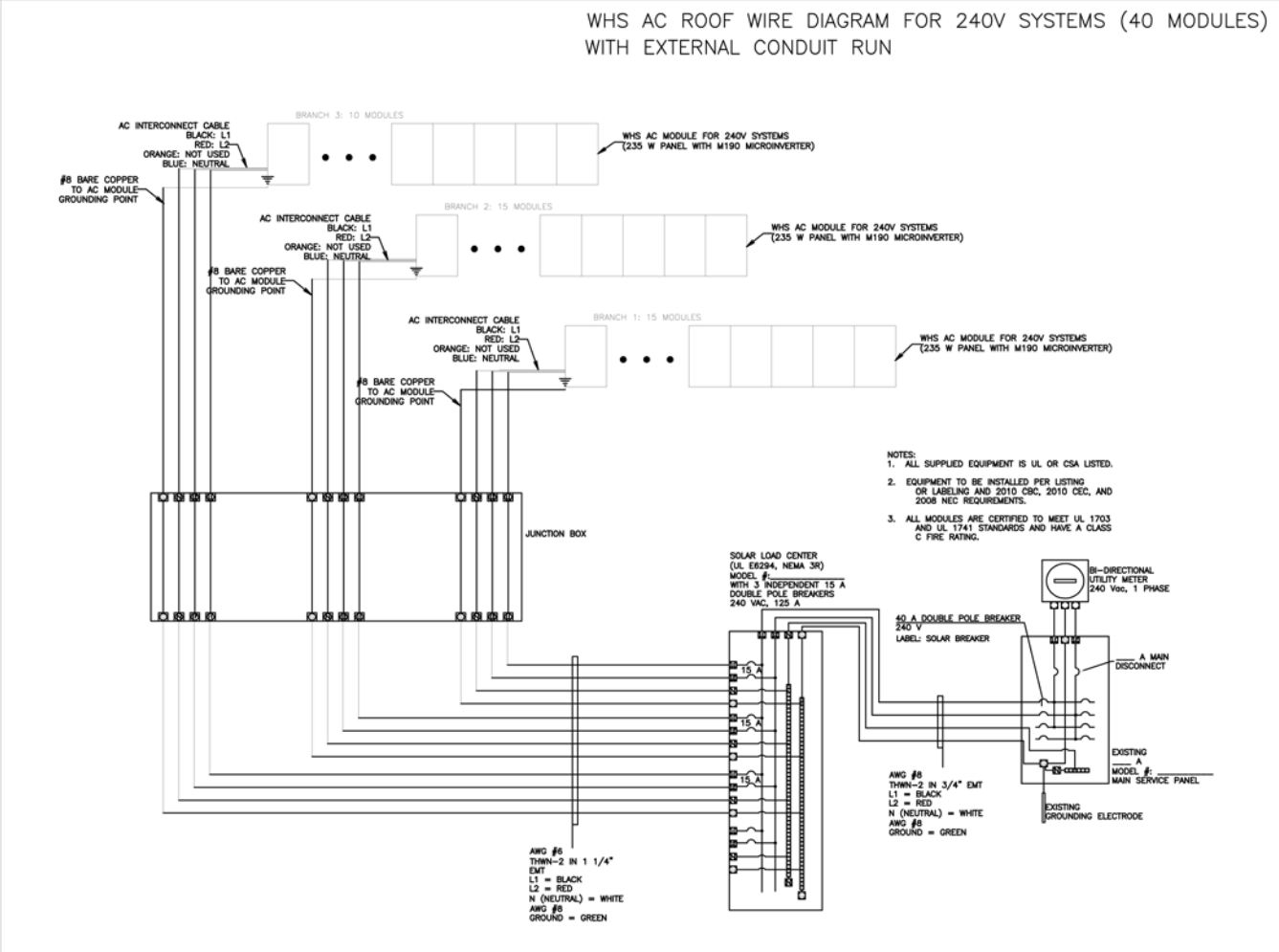
6.3.3: 40 Modules



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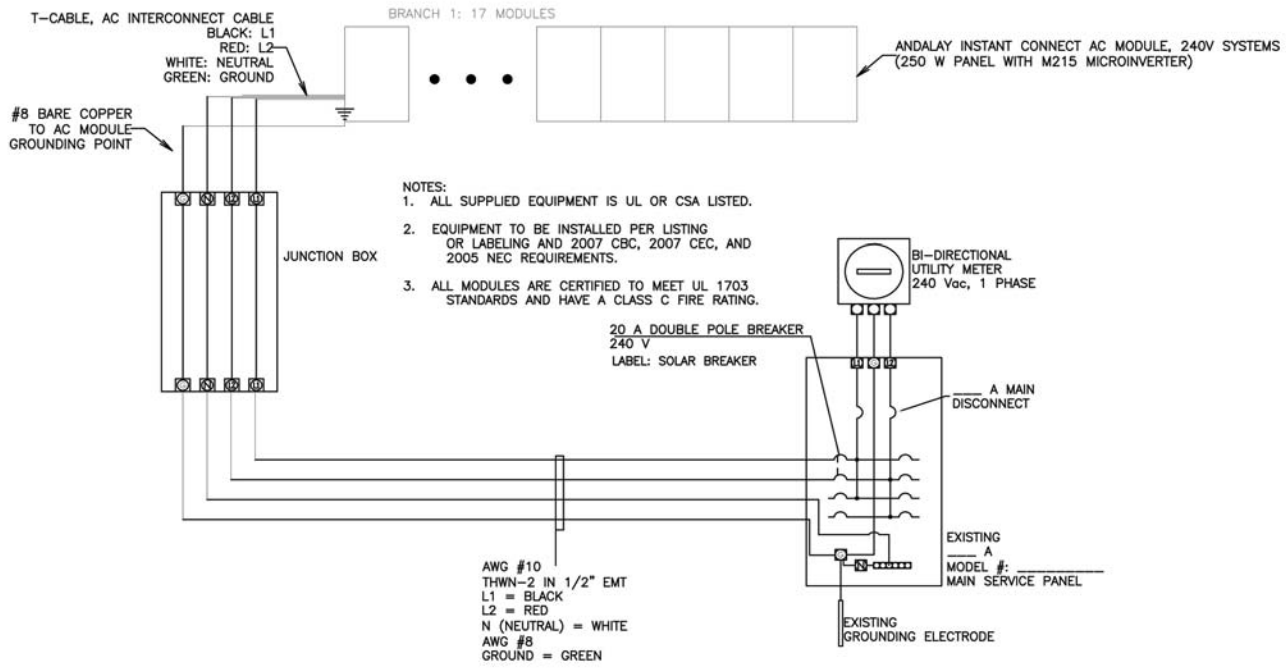
6.4: M215 Wiring Diagrams

6.4.1: 17 Modules

WHS AC INSTANT CONNECT ROOF WIRE DIAGRAM FOR 240V SYSTEMS (17 MODULES) WITH EXTERNAL CONDUIT RUN



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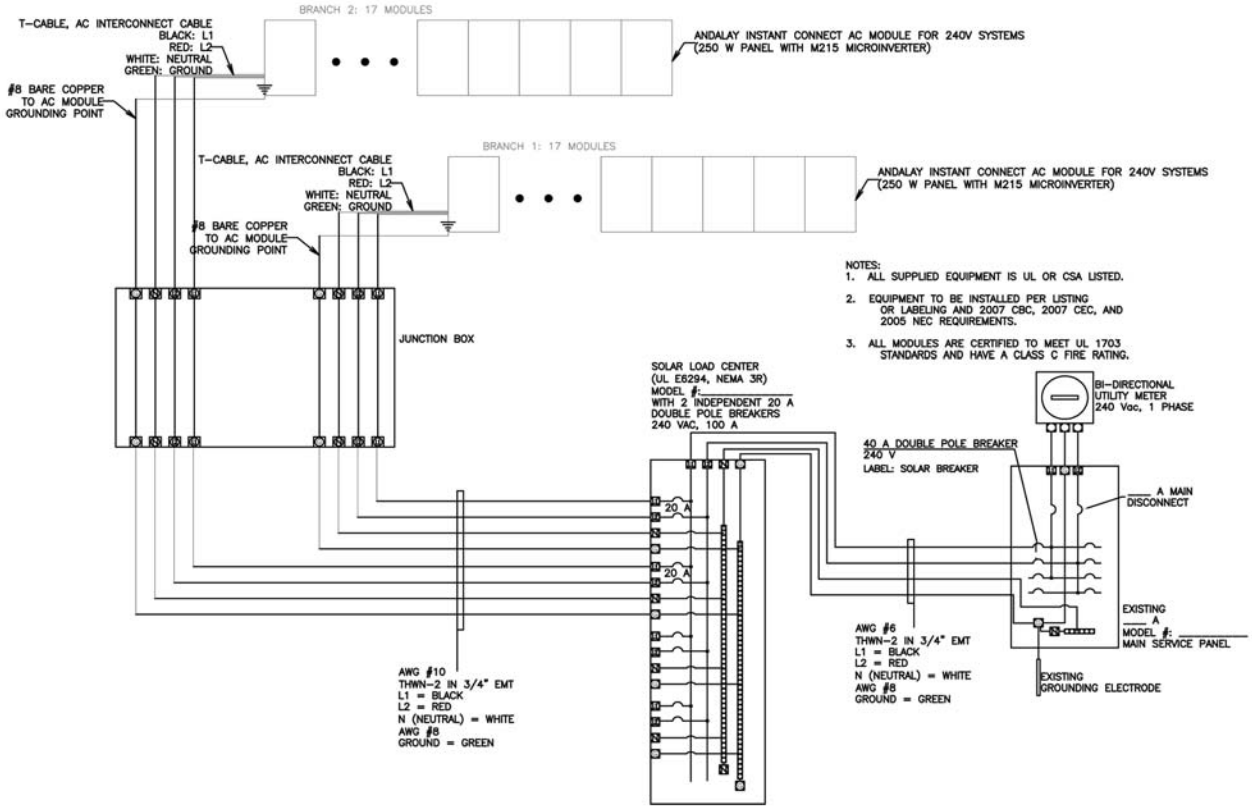
6.4.2: 34 Modules

WHS AC INSTANT CONNECT ROOF WIRE DIAGRAM FOR 240V SYSTEMS (34 MODULES) WITH EXTERNAL CONDUIT RUN


BRANCH 2: 17 MODULES
T-CABLE, AC INTERCONNECT CABLE
BLACK: L1
RED: L2
WHITE: NEUTRAL
GREEN: GROUND
ANDALAY INSTANT CONNECT AC MODULE FOR 240V SYSTEMS (250 W PANEL WITH M215 MICROINVERTER)
#8 BARE COPPER TO AC MODULE GROUNDING POINT
BRANCH 1: 17 MODULES
T-CABLE, AC INTERCONNECT CABLE
BLACK: L1
RED: L2
WHITE: NEUTRAL
GREEN: GROUND
ANDALAY INSTANT CONNECT AC MODULE FOR 240V SYSTEMS (250 W PANEL WITH M215 MICROINVERTER)
#8 BARE COPPER TO AC MODULE GROUNDING POINT
NOTES:
1. ALL SUPPLIED EQUIPMENT IS UL OR CSA LISTED.
2. EQUIPMENT TO BE INSTALLED PER LISTING OR LABELING AND 2007 CBC, 2007 CEC, AND 2005 NEC REQUIREMENTS.
3. ALL MODULES ARE CERTIFIED TO MEET UL 1703 STANDARDS AND HAVE A CLASS C FIRE RATING.
JUNCTION BOX
SOLAR LOAD CENTER (UL E6294, NEMA 3R)
MODEL #:
WITH 2 INDEPENDENT 20 A DOUBLE POLE BREAKERS
240 VAC, 100 A
BI-DIRECTIONAL UTILITY METER 240 Vac, 1 PHASE
40 A DOUBLE POLE BREAKER 240 V
LABEL: SOLAR BREAKER
A MAIN DISCONNECT
20 A
20 A
EXISTING A MODEL #: MAIN SERVICE PANEL
AWG #10 THWN-2 IN 3/4" EMT
L1 = BLACK
L2 = RED
N (NEUTRAL) = WHITE
AWG #8
GROUND = GREEN
AWG #6 THWN-2 IN 3/4" EMT
L1 = BLACK
L2 = RED
N (NEUTRAL) = WHITE
AWG #8
GROUND = GREEN
EXISTING GROUNDING ELECTRODE

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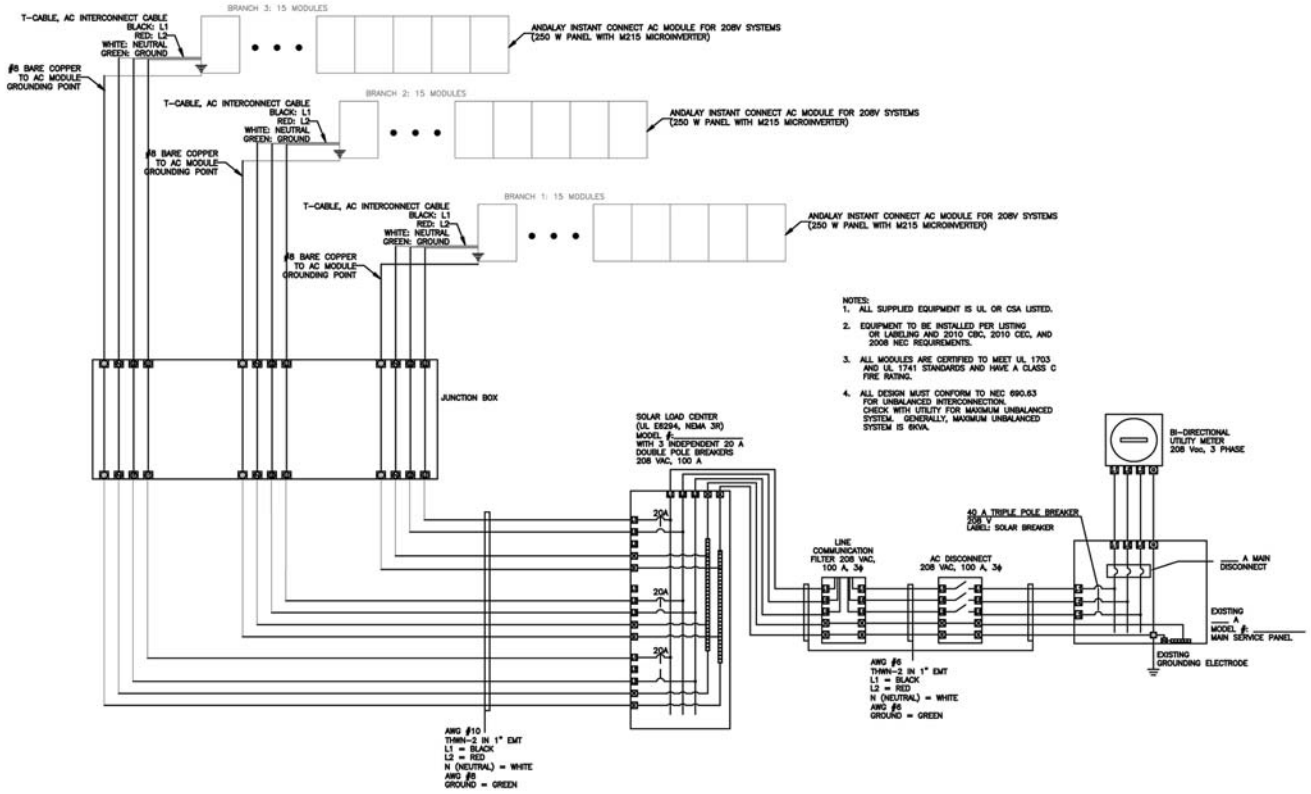
6.4.3: 45 Modules

WHS AC INSTANT CONNECT ROOF WIRE DIAGRAM FOR 208V SYSTEMS (45 MODULES) WITH EXTERNAL CONDUIT RUN


BRANCH 3: 15 MODULES
T-CABLE, AC INTERCONNECT CABLE
BLACK: L1
RED: L2
WHITE: NEUTRAL
GREEN: GROUND
#8 BARE COPPER TO AC MODULE GROUNDING POINT
ANDALAY INSTANT CONNECT AC MODULE FOR 208V SYSTEMS (250 W PANEL WITH M215 MICROINVERTER)
BRANCH 2: 15 MODULES
BRANCH 1: 15 MODULES
JUNCTION BOX
NOTES:
1. ALL SUPPLIED EQUIPMENT IS UL OR CSA LISTED.
2. EQUIPMENT TO BE INSTALLED PER LISTING OR LABELING AND 2010 CBC, 2010 CEC, AND 2008 NEC REQUIREMENTS.
3. ALL MODULES ARE CERTIFIED TO MEET UL 1703 AND UL 1741 STANDARDS AND HAVE A CLASS C FIRE RATING.
4. ALL DESIGN MUST CONFORM TO NEC 690.63 FOR UNBALANCED INTERCONNECTION. CHECK WITH UTILITY FOR MAXIMUM UNBALANCED SYSTEM. GENERALLY, MAXIMUM UNBALANCED SYSTEM IS 6KVA.
SOLAR LOAD CENTER (UL E8294, NEMA 3R)
MODEL #
WITH 3 INDEPENDENT 20 A DOUBLE POLE BREAKERS
208 VAC, 100 A
20A
LINE COMMUNICATION FILTER 208 VAC, 100 A, 3φ
AC DISCONNECT 208 VAC, 100 A, 3φ
40 A TRIPLE POLE BREAKER 208 V
LABEL: SOLAR BREAKER
BI-DIRECTIONAL UTILITY METER 208 Vac, 3 PHASE
A MAIN DISCONNECT
EXISTING A MODEL # MAIN SERVICE PANEL
EXISTING GROUNDING ELECTRODE
AWG #10 THWN-2 IN 1" EMT
L1 = BLACK
L2 = RED
N (NEUTRAL) = WHITE
AWG #8 GROUND = GREEN
AWG #6 THWN-2 IN 1" EMT
L1 = BLACK
L2 = RED
N (NEUTRAL) = WHITE
AWG #6 GROUND = GREEN

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Chapter 7: Support

Andalay Solar offers a number of convenient ways to contact us to answer questions about the product, installation, operation, or warranty.

7.1: Contacting Andalay Solar

You may contact Andalay Solar in any of the following ways:

Phone:	1.888.395.2248
Email:	techsupport@Andalaysolar.com
Fax:	1(866) 685-7702
Mail:	Andalay Solar Attention: Tech Support 1475 South Bascom Ave Suite 101 Campbell, CA 95008

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Andalay® Solar

Sloped Roof Mounting System Install Guide - V2 60-Cell Modules

v2.5 - November, 2013

Andalay Solar
Attention: Tech Support
1475 South Bascom Ave
Suite 101
Campbell, CA 95008

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